U.S. Department
of Transportation

United States
Coast Guard

Commandant
United States Coast Guard

(G-NRN)
Washington, DC 20593-0001
(202) 267-0283

COMDTINST M16500.13
3 Jan 1989

COMMANDANT INSTRUCTION M16500.13 (Old CG-222-4)

Subj: Aids to Navigation Manual - Radionavigation

1. PURPOSE. This manual establishes policy and prescribes procedures for the administration of the Cost Guard Radio Aids to Navigation Program.

2. DIRECTIVES AFFECTED. CG-222-4 is cancelled.

3. MAJOR CHANGES. This edition of the Aids to Navigation Manual - Radionavigation is a complte revision of the previous manual. Major changes include:

   a. Delegation of Coordinated Universal Time (UTC) responsibilities, (Chapter 2, section B.3),

   b. Remote Operating System (ROS) operations, (Chapter 2, section C.5 and D.6),

   c. Revised Loran-C Operations Awards requirements, (Chapter 2, section E.2),

   d. Loran-C Tower Ligth Outage Reports, (Chapter 2, section E.3),

   e. Control, Communications, and Monitor Plan (CCMP) requirements,

      (Chapter 2, section E.7),

   f. OMEGA System Operations, Chapter 3).

4. RECOMMENDED CHANGES. Unit Commanding Officers and individual members may recommend changes by writing, via the chain ofcommand, to Commandant (G-NRN).

5. Action. Area and district commanders, Commander, Coast Guard Activities Europe, commanders of maintenance and logistics commands and unit commanding officrs shall ensure that personnel comply with the policies and procedures contained in this manual.

/s/ R. T. NELSON
Chief, Office of Navigation Safety
and Waterway Services

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CHAPTER 1. MARINE RADIOBEACON SYSTEM OPERATIONS

A. Description of the Marine Radiobeacon System.

1. Purpose. The Marine Radiobeacon System provides all weather navigation information to enable vessels fitted with direction-finding equipment to take a bearing or to take several consecutive bearings which will provide a fix. Radiobeacon service is available in most important navigational areas.

2. Types of Marine Radiobeacons. Marine radiobeacons operate in the 285 kHz to 325 kHz frequency band. The transmitted signal consists of two separate carrier frequencies; a continuous carrier at the assigned operating frequency and a keyed carrier 1.02 kHz higher in frequency which provides the identifying characteristic. The tansmitted intelligence consists of a series of Morse characters and long dashes arranged to provide a unique identifying sequence for each station. A detailed list of the locations; and characteristics of radiobeacons is published in the Light List, (COMDTINST M16502 (Series)). For description purposes, marine radiobeacons are grouped in three categories.

   a. Continuous Radiobeacon. These readiobeacons operate continuously through every minute of the hour. Morse characters are assigned as identificaiton codes and are transmitted at six words per minute. Once each minute the code is interrupted by a 10-second dash to allow mariners to refine their bearings. This is the preferred method of operation.

   b. Sequenced Radiobeacon. In order to make more efficient use of the frequency spectrum, marine radiobeacons in the same geographical area, except those operating continuously, are organized into groups of up to six readiobeacons that transmit on a signle frequency. The 10-second dash is always the last ten seconds of each minute. Typically, one station in each group transmits for one minute out of six and is silent during the remaining five minutes. When there are less than six beacons in a group, one or more stations may transmit more often in the sequence. Sequenced radiobeacons are not available for continuous operation for calibration pruposes. Sequenced radiobeacons are also assigned Morse letters for identification and the code is transmitted at six words per minute.

   c. Calibration Radiobeacons. Special calibration readiobeacons are installed at certain locations to provide signals for calibration of shipboard radio direction finders. The signals are transmitted continuously during the time required by a vessel for calibration. The identifying characteristic is acombination of dots and dashes repeated twice, tollowd by a 20-second dash. Calibration radiobeacons transmit on a frequency within the radiobeacon band, 285 to 325 kHz an on 480 kHz. In addition, two frequencies in the 2 MHz band may be made available to government SAR vessels only.

1.A.3. Marine Radiobeacon Equipment. The equipment on a radiobacon station consists of a coder, transmitter, an antenna coupler and an antenna. Other equipment used for monitoring station operation include an alarm-monitor unit, a reflected-power meter, and a receiver. In addition, sequenced stations have electronic timers which time the station's operation.

a. Primary Equipment.

(1) Transmitter. The transmitter generates the radiobeacon signal that is radiated into space. The size of the transmitter depends on the desired range of the radiobeacon. Since the transmitter and antenna are seldom close together, the transmitter is designed to feed its output power into a transmission line which runs to the antenna.

(2) Antenna Coupler. As its name indicates, this equipment couples the transmitter power into the antenna. If is designed to match the transmission line characteristics to those of the antenna.

(3) Antenna. The antenna radiates the power generated by the transmitter into space. The power is radiated in all directions from the antenna at the speed of light. The efficiency of the antenna is improved by a good ground-wire system. Long-range stations have larger antennas to handle the greater power required.

(4) Coder. The coder controls the transmitter, creating the beacon identification signal and, in the case of sequenced stations, an external timer is used to turn the transmitter on and off at the proper times.

(5) Timer. Sequenced stations must operate on a time schedule and are therefore equipped with electronic timing devices. The timer controls the coder by sending it a signal at the beginning of each minute.

b. Auxiliary Equipment.

(1) Alarm Monitor. This device is actually a radiobeacon receiver which monitors the signal readiated from the antenna and sets off an alarm if a discrepancy is detected.

(2) Reflected-Power Meter. This unit provides an indication of how well the transmitter power is being radiated by the antenna, which indicates the condition of ghe transmission line, antenna coupler, and the antenna itself.

(3) Receiver. This is usuallly an ordinary communications receiver and is used for receiving standard time signals to check the timers on sequenced stations.

c. Changes to Equipment. Any changes in radiobeacon equipment or its operation are required to conform to COMDTINST M16500.13 (series) and be made when directed by the Commandant.

1.B. **Operating Instructions.**

1. Monitoring Requirements. To ensure maximum availability of signals, radiobeacons must be montiored. A radiobeacon monitoring plan from each district is required and will be reflected in the District Operation Plan. The general requirements for monitoring are as follows:

   a. All radiobeacons, either attended or unattended, fitted for automatic monitoring need not be monitored in any other manner unless there is evidence of a monitoring equipment malfunction.

   b. All radiobeacons, either attended or unattended, not fitted for automatic monitoring shall be monitored by a radio communication receiver once every eight hours, or more at the discretion of the District Commander.

   c. Calibration radiobeacons have no monitoring requirement since they are energized only on request.

2. Monitoring Procedures. Whenver possible, each radiobeacon shall be equipped for automatic monitoring. The watchstander will be alerted if the following irregularities exist:

   a. Incorrect timing of sequenced beacons

   b. Modulation that exceeds the 70% 5% allowable range

   c. Low signal strength

   d. Improper code characteristic.

   When a radiobeacon is not equipped for automatic monitoring, then monitoring for these irregularities shall be accomplished through the use of radio communications receiver. After defective operation of a radiobeacon has been detected and restoration of normal primary operation is unsuccessful (at automated monitor points), a message report shall be immediately forwarded to the Maintenance and Logistics Command, District Commander and supporting electronic shop.

3. Timing Signals. The following signals can be used to verify the timing of a sequenced beacon:

   a. National Bureau of Standards Time Ticks. The National Bureau of Standards operates radio stations WWV (Fort Collins, Colorado) and WWVH (Maui, Hawaii) which broadcast time information for the United States. Station WWV broadcasts on standard radio frequencies of 2.5, 5.0, 10.0, 20.0 and 25.0 MHz. The broadcasts are continuous night and day, except that WWV is off the air for approximately four minutes each hour. The silent period commences at 45 minutes, 15 seconds after each hour. Station WWVH broadcasts on standard radio frequencies of 2.5, 5.0, 10.0 and 15.0 MHz. The WWVH broadcast is interrupted for a four minute silent period from 15 to 19 minutes past each hour. Greenwich Meam Time (GMT) is announced in telegraphic code each five minutes from WWV and WWVH. This provides a quick reference

1.B.3.a. (Cont'd) to correct time when a timepiece may be in error by a few minutes. The 0000-2400 hours system is used starting with 0000 at midnight. The first two figures give the hours when the tone returns. For example, at 1655 GMT, or 11:55 a.m. Eastern Standard Time, four figures (1, 6, 5 and 5) are broadcast in code. The time announcement refers to the end of an announcement interval, i.e., when the audio frequencies are resumed. At station WWV, a voice announcement of Greenwich mean time is given after each telegraphic code announcement. For example, at 0910 GMT, the voice announcement is:

"National Bureau of Standards, WWV Fort Collins, Colorado; next tone begins at nine hours, ten minutes Greenwich Mean Time."

b. CHU Canadian Time Ticks. Canada's official time is transmitted by radio stration CHU on standard radio frequencies of 3,330 kHz, 7,355 kHz and 14,670 kHz. The second pulse consists of a cone-fifth of a second burst of 1,000 Hz tone with certain omissions and identifications. Omission of the 29th pulse identifies the half minute and omission of the 51st through 59th pulses provides a window for the voice announcement. The zero pulse of each minute is one half-second long and the hour is identified by a pulse of one full-second followed by 12 seconds of silence. The bilingual voice announcement which is heard each minute takes the form:

"CHU Canada eastern standard time__________ Hours ________Minutes ________heures ________ minutes" (even minutes).

"CHU Canada hours normal de 1' est ________heures ________minutes, ________hours ________ minutes" (odd minutes).

"CHU Canada eastern standard time ________hours exactly, ________heaures preceises" (on the hour).

c. Taking the Time Tick. The time tick is taken by tuning the radio receiver to one of the frequencies. The voice announcement will indicate what the time will be when the minute pulse or hour pulse occurs. At the instant the pulse occurs, the electronic timer's time is noted. The electronic timer is then manually corrected to coincide with the standard time from CHU.

4. Operating, Maintenance and Safety Instructions. A set of instructions shall be posted in the vicinity of the radiobeacon equipment. These instructions shall include the material from the Aids to Navigation Operation Bill and the following:

a. The normal antenna current meter readings and equipment adjustments logged by the technician.

b. Antenna current meter reading at 50% rated power output.

c. The procedure for adjusting the equipment to maintain the proper radiated field (as indicated by meter or alarm-monitor).

d. The procedure for correcting electronic timers.

1.B.4.e. Maintenance requirements.

f. Form CG-4139, Radiobeacon Field Intensity Measurement.

5. Special Instructions for Calibration Radiobeacons. The equipment shall be operated whenever required by a vessel for calibration of its radio direction finder. Requests for calibration may originate from the district office or directly from the vessel desiring calibration. The request from the vessel may be given by radiotelephone, whistle signal, searchlingt, flag signals, or by hail. Request by whistle signal will consist of three long blasts followed by three short blasts. Request by international flag signal will be the letter "O" over the letter "Q" meaning "I am about; to swing for compass adjustment." All flag, whistle, or other signals from ships are acknowledged by starting the radiobeacon. If the station cannot provide the service requested, the vessel must be informed as soon as possible. Upon receipt of advance notice that a vessel desires calibraiton service at a specific time and date, the unit shall take necessary action to place the radiobeacon in operation at the designated time and date. The radiobeacon shall be left in operation until the calibrating vessel makes the prescribed signal that calibration is completed, or for a period of one hour after the vessel departs the area if no signal is made. If the calibrating vessel does not come into sight of the station and no communication is established, the radiobeacon shall be put into operation for a period of at least four hours. If the calibrating vessel has not come into sight or communicated with the unit before expiration of the four-hour period, the radiobeacon may be secured.

6. Granting Off-Air Time. District Commanders are authorized to grant off-air time for the maintenance of radiobeacons. Supporting Electronics Shops or Electronics Maintenance Detachments shall request off-air time from the District Commander, giving as much adbance notice as possible (up to 30 days) so that appropriate Notices to Mariners can be issued. To the extent practicable, radiobeacon off-air time should be scheduled during periods of good visibility. Whenever possible, scheduled off-air time shall be canceled when the visibility is or is expected to be less than five miles. Off-air time must be kept to a minimum.

7. Maintenance.

a. Background and Purpose. Each major radiobeacon equipment has a technical manual. These manuals describe the theory, installation, operation, and maintenance of the equipment. Lists of parts are also included. These manuals are primarily for use by technicians but station personnel are encouraged to study them for a better understanding of how their particular station operates. Eacm manual has a section on operator's maintenance which contains information on such maintenance procedures as can be performed by a non-technical operator. The manuals describe certain procedures for internal reapir of the equipment. Except as specfically authorized by the District Commander, internal repairs by non-technical personnel are not authorized. Although most mainteannce is of technical nature and is not required of station personnel, some operator's maintenance is required. In order to approach and maintain a high standard of performance for al electronic equipment installed, each unit should

1.B.7.a. (Cont'd) have an operator's maintenance program which is set up using the following outline as a guide:

(1) Cleanliness. Assign a responsible person to maintain the external cleanliness and general outward appearance of all electronic equipment.

(2) Testing. By applying power and operating in a normal manner, test all equipmen on a daily basis. Refer to operating plaque and the technical manual for operator's instructions. Malfunctioning equipment shall be reported to the supporting electronic repair shop imemdiately.

(3) Inspection. Inspect each piece of electronic equipment weekly for:

(a) Loose or chafed power cords and cables.

(b) Smooth operation of external controls.

(c) Security of transmission line antenna connections, bonding straps, etc.

(4) Antennas. Inpsect all antennas periodically (including antenna lead-in and insulators) for corrosiion, paint, frayed wire, and rust. These items constitute a possible cause of operational failure of equipment and should be corrected at once. Insulators must be kept free of paint and cleaned with fresh water periodically to remove salt and dirt deposits. Power must be secured to work safely on transmitting antenna insulators.

(5) Spare Parts. Maintain a complete listing of electronic repair parts on hand an immediately check off parts as they are used. Reorder replacement parts in accordance with information furnished by the electronics repair facility.

b. District Instructions. District Commanders shall issue specific instructions concerning the nature and extent of repairs which non-technical operating perosnnel are required to make. Training programs shall be established to provide operating personnel with the knowledge necessary to perform any maintenance required of them. Personal safety must be empahsized.

C. System Standards. This section prescribes operating standards and tolerances for the U.S. marine radiobeacon system.

1. Frequency.

a. Continuous Carrier. The continous carrier shall be maintained within 0.01% of the assigned radiobeacon frequency.

b. Keyed Carrier. The keyed carrier shall be 1020 Hz higher in frequency than the continous carrier and shall be maintained within 0.01% of the resultant frequency (continuous carrier frequency plus 1020 Hz).

1.C.2. Modulation. The voltage level of the keyed carrier shall be set a 70% of the amplitude of the continuous carrier. The tolerance is 5%.

3. Timing. The timing of radiobeacon transmissions shall be maintained to within three seconds of Greenwich Mean Time.

4. Field Strength

a. Service Range. Upon establishment, marine radiobeacons are assigned a service range. The service range is the minimum range, consistent with the operational needs of the mariner, and is specified for each radiobeacon in the Aids to Navigation Operation Bill, CG-2814.

b. International Specifications. Pursuant to the International Radio Regulations (Geneva, 1959), the service range of marine radiobeacons is based on a field strength of 50 microvolts per meter at the limit of service range north of 40 N, 75 microvolts per meter between 31 N and 40 N, and 100 microvolts per meter south of 31 N. The signal strength of a marine calibration radiobeacon shall not exceed 50 microvolts per meter at 10 nautical miles under any cicumstances.

c. Minimum Field Strengths. Field strength should be maintained 0 to -3dB at the limit of the radiobeacon service range. A reduction below -3dB requires a report of failure to the supporting electronic shop.

Direction Finder Selectivity Specifications

Frequency Deviation (kHz)	Attenuation (dB)	Signal Rejection Ratio
0	0	1.0
2	3	1.4
4	25	17.5
6	50	30.0
9	70	3000.0
12	80	10,000.0
3	12	4.0

5. Protection Ratios. The protection ratio of radiobeacon is defined as the ratio of the signal strength of the desired radiobeacon at the limit of its advertised range and the undesired (interfering) radiobeacon. This ratio is expressed in dB. The protection ratio of calibration radiobeacons is established at 28 dB. For all other radiobeacons the protection ratio is 15 dB. These protection ratios are based on the direction finder selectivity specifications shown in Table 1-1.

D. Policies.

1. General. This section publishes policies which have been established by the Commandant with regard to the establishment and operation of marine radiobeacons. Since these policies are necessarily broad in nature, some exceptions will be necessary from time to time. However, the reasons for departing from established policy must be documented and approved by the Commandant.

2. Policy Statements.

   a. User Needs. The needs of recreational boaters shall be given full consideration in planning the marine radiobeacon system.

   b. Antenna Locations. Radiobeacon transmitting antennas shall be located where they will most benefit the user. Maintenance considerations are secondary.

   c. Minimum Range. There are no minimum ranges for marine radiobeacons.

   d. Sequencing. The sequencing of marine radiobeacons is undesirable.

3. Service Arc Calibration. Radiobeacon services arcs, except those of Large Navigational Buoys (LNBs) shall be calibrated on the following occassions:

   a. Initial. When the radiobeacon is initially established.

   b. Alterations. Upon completion of any major alterations involving movement or replacement of the radiobeacon antenna.

   c. Nearby Structural Changes. After removal, alteration or contruction of structures near the radiobeacon antenna that might result in distortion of the radiation pattern.

4. The Electronics Maintenance Manual (COMDTINST M10550.14) contains technical instructions for calibrating service arcs. The District Commander is authorized to declare a radiobeacon operational if the maximum bearing error in all quadrants is less than or equal to plus or minus two degrees. The Commandant (G-NRN) shall be notified by letter when a new installation is declared operational. A copy of the service arc calibration data shall also be forwarded. When the data shows any bearing error exceeding plus or minus two degrees, all data shall be forwarded to Commandant (G-NRN) for further action.

CHAPTER 2. LORAN-C OPERATIONS

A. Introduction.

1. Purpose and Objectives. The purpose and objectives of the U.S. Coast Guard Loran-C system are presented below. This chapter applies to all Coast Guard staffed and unattended stations and to host nation-staffed stations as agreed upon by treaty.

   a. Loran-C. Coast Guard Loran-C chains provide a hyperbolic system of radionavigation throughout a large area of the world. Because of the inherent accuracy of the system, ships and aircraft use the Loran-C system in all weather conditions over land and sea to obtain high accuracy position information. Performance goals for Coast Guard Loran-C is 99.9% signal availability for a Loran Station and 99.7% availability for a Loran-C triad including authorized off-air time.

   b. Loran-C Operations. This chapter defines the Loran-C chain of command and provides standard operations. In addition, it procedures, recovery procedures for casualty control, and guidelines for day-to-day operations. In addition, it establishes data collection requirements fo both short-term and long-term control, and reporting requirements for the Loran-C system.

2. Authority. The Coast Guard's legal authority for establishing, maintaining, and operating Loran-C radionavigation aids is based primarily on the following documents. Excerpts pertinent to Loran-C are summarized below:

   a. 14 USC 81: Aids to Navigation Authorized. In order to aid navigation and to prevent disasters, colisions, and wrecks of vessels and aircraft, the Coast Gaurd may establish, maintain, and operate Electronic Aids to Navigation systems:

      (1) required to serve the needs of the Armed Forces of the United States peculiar to warfare and primarily of military concern as determined by the Secretary of Defense or any department within the Department of Defense; or

      (2) required to serve the needs of the maritime commerce of the United States; or

      (3) required to serve the needs of the air commerce of the United States as requested by the Administrator of the FAA.

2.A.2. b. 14 USC 82: Cooperation with Administrator of the FAA. The Coast Guard, in establishing, maintaining, or operating any aids to air navigation herein provided, shall solicit the cooperation of the Administrator of the FAA to the end that the personnel and facilities of the FAA will be utilized to the fullest possible advantage.

c. 33 CFR 60.01(C). The Coast Guard maintains systems of marine aids to navigation consisting of visual, audible and electronic signals which are designed to assist the prudent mariner in the process of navigation.

3. References. This Manual is not intended to be the sole source of reference and guidance material for Loran-C operations. Additional instructions and publications applicable to Loran-C operations include, but are not limited to.

a. Chain Operation Orders (OPORDERS). Coordinators of Chain Operations (COCO's), Control Stations, and Loran-C Stations (LORSTA's) shall maintain all current Commandant, Area, regional, and chain OPORDERS for their Chain(s).

b. Chain Instructions. Additional instructions such as letters, memo, messages, Standard Operating Procedures (SOP's), etc., originate at Commandant, Regional, and Chain levels. In every case, material in these instructions shall not contravene policy established by higher authority. Copies of all pertinent instructions should be maintained by the orginator as well as by all those affected

c. Refernce Publications. There are a number of other publications with information about Loran-C operations, history, support, and the system in general. The publications listed below are required.

(1) Specification of the Transmitted Loran-C Signal, COMDTINST M16562.4.

(2) Radionavigation Systems, G-NRN, current edition.

(3) USCG Tower Manual, COMDTINST M11000.4.

(4) USCG Electronics Manual, COMDTINST M10550 series.

(5) Loran-C User Handbook, COMDTINST M16562.3.

(6) Federal Radionavigation Plan (FRP), current edition.

(7) MILSTRIP Manual, DOD 4140.17-M.

(8) Coast Guard Aids to Navigation, COMDTINST M16502.8 (old CG-193).

(9) Applicable equipment technical manuals.

2.B. **Command and Control.**

1. Introduction. All Coast Guard Loran-C operations, and the associated support activities, will be accomplished within the framework of the standard Coast Guard organization. The management, supervision, or accomplishment of every function which must be performed within the Coast Guard to operate and suypport the Loran-C system will be the assigned responsibility of a specified Coast Guard Headquarters Office or field command. Deviations from the organizational assignments and the procedures outlined herein are not authorized. If circumstances so indicate, a proposal to change organizational assignments or procedures may be submitted to Commandant (G-CGS) for approval. Proposed organization changes should be submitted in accordance with the Coast Guard Organization Manual (COMDTINST M5400.7).

2. Organizational Structures.

   a. Headquarters Organization.

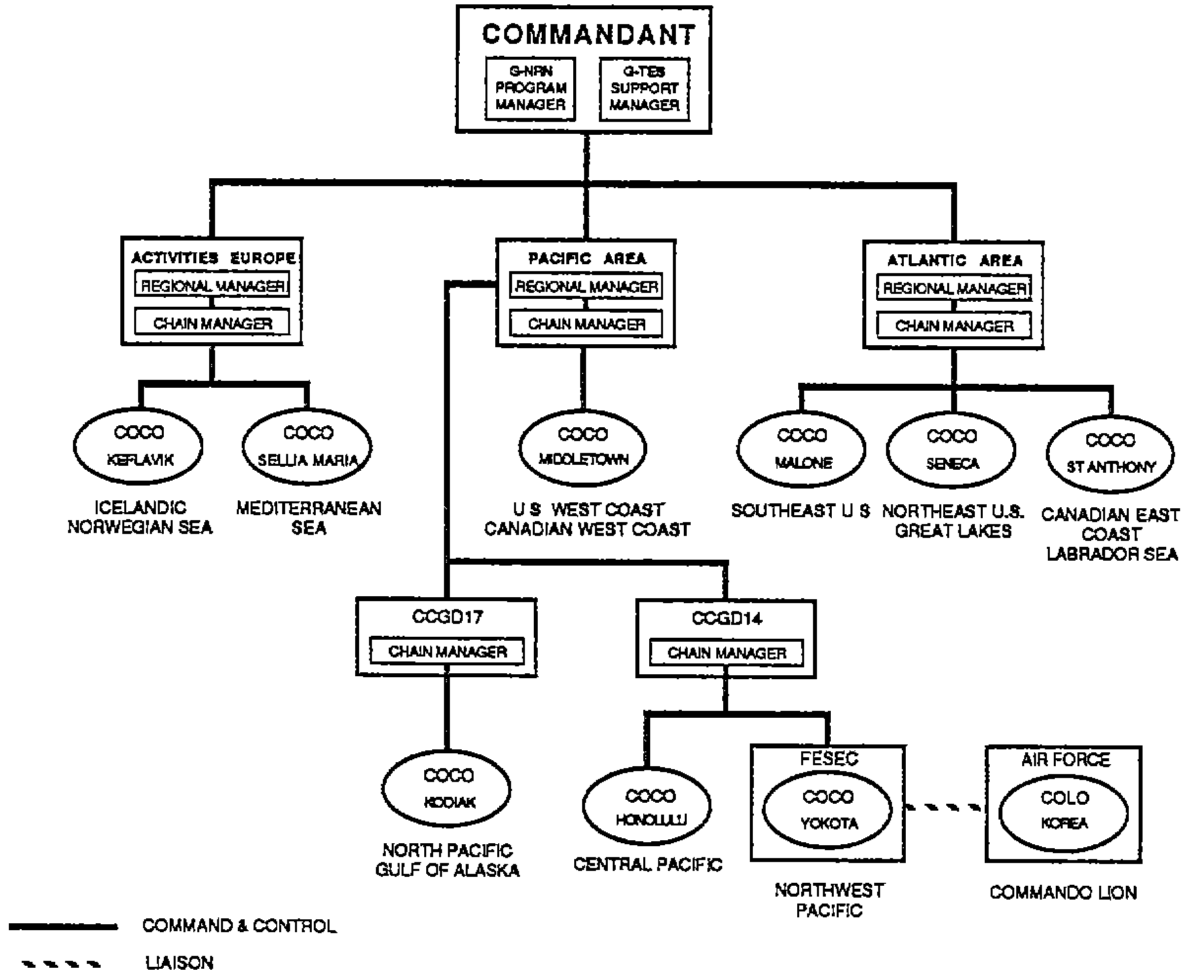
      (1) Commandant. The Commandant, assisted by Headquarters staff plans, directs, coordinates, and evaluates Coast Guard activities carried out by the Area, District, and Activities Commanders; and provides immediate direction to Headquarters' units. Figure 2-1 shows the Loran-C Command and Control organizational structure from Commandant to the chain level.

      (2) Program Manger. The Chief, Radionavigation Division (G-NRN), under the direction of Chief, Office of Navigation Safety and Waterway Services (G-N), is the Loran-C Program Manager. Acting under authority delegated by the Commandant, the Program Manager provides policy guidance, and directs and coordinates service-wide functions necessary for the management and operation of the Loran-C system.

      (3) Support Manager. The Chief, Electronics Systems Division (G-TES), under the direction of Chief, Office of Command, Control, and Communications (G-T), is the Loran-C Support Manager. Acting under authority delegated by the Commandant, the Support Manager directs and coordinates service-wide functions as necessary to the electronics engineering support of the Loran-C system.

   b. Regional and Chain Organization.

      (1) Regional Manager (RM). The Commandant has delegated the authority and responsibility to promulgate Loran-C policy and procedures to Headquarters Office Chiefs. To implement these policies and procedures, the responsibility for the direct supervision and management of Coast Guard Loran-C operations is assigned to the Regional Managers. Commander, Atlantic Area, Commander, Pacific Area, and Commander, Coast Guard Activies Europe are the Regional Managers of the Coast Guard Loran-C system. Each directs and coordinates all Coast Guard Loran-C operations within their assigned region of responsibility. Figures 2-2, 2-3, and 2-4 show the Loran-C Command and Control



Loran-C Command and Control Commandant to COCO.

2.B.2.b. (1) (Cont'd) organizational structure from the Regional Manager to the unit level for all U.S. controlled Loran-C stations currently in existence.

(2) Chain Manager (CM). A chain manager is assigned responsibility for the immediate direction and supervision of the day-to-day operation of a Loran-C chain. The district Commander or Commander, Coast Guard Activities, Europe shall be designated Chain Manager when all Staffed stations which constitute the chain are within their respective geographic juridictions. If not, the Area Commander shall be designated Chain Manager.

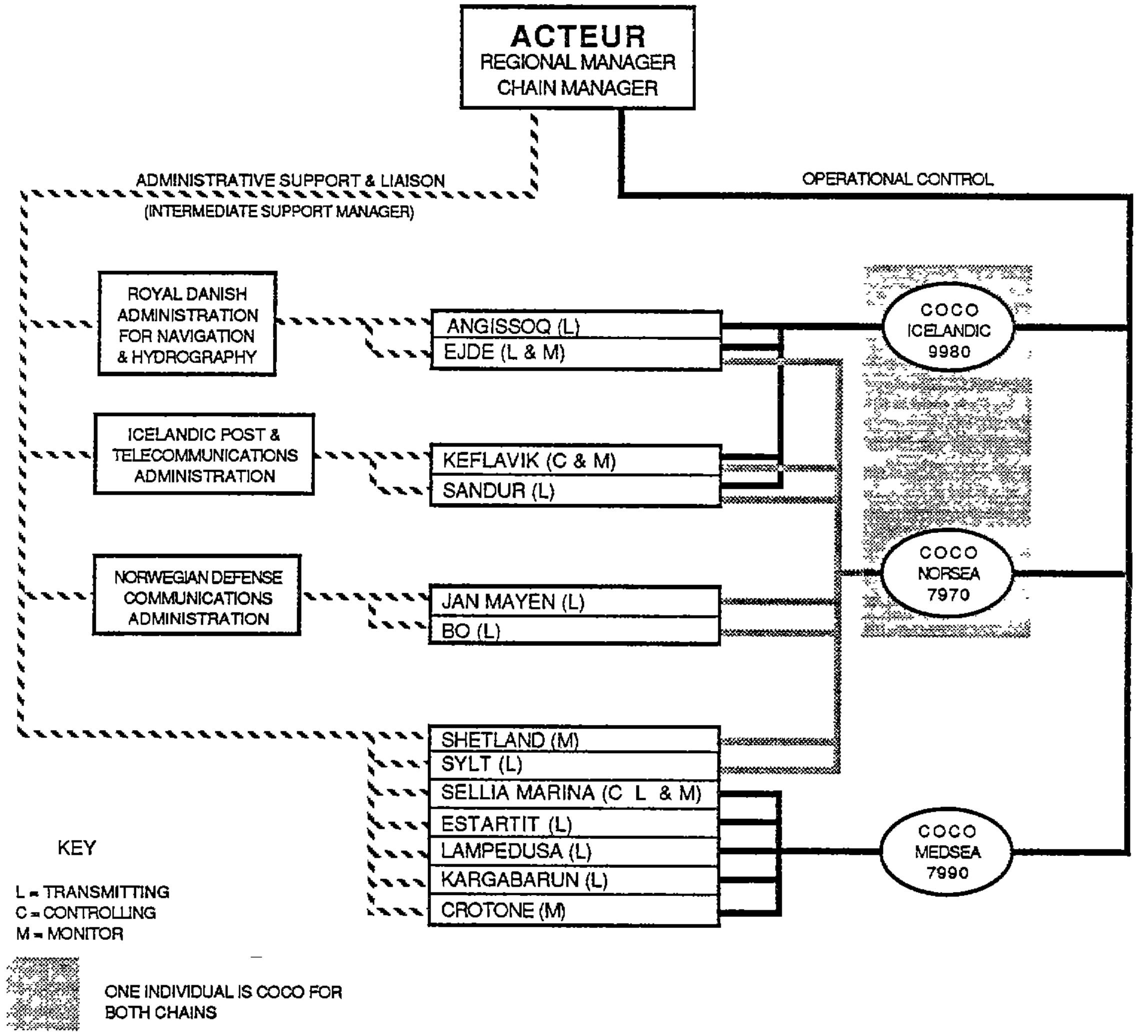
A Section or Group Commander, if appropriate in a particular case, may be designated to perform some of the operational functions of Chain Manager. The assignment of such a subordinate commander to perform some of the functions of the Chain Manager is subject to the approval of the Commandant. The overall responsibility of the District Commander to supervise and direct general operations is not altered such delegation of authority. The title and overall responsibility of the Chain Manager shall not be delegated below the District or Activities Europe command levels.

(3) Intermediate Support Manager. The maintenance and Logistics Commands (MLC), District Offices and host nation agencies act as intermediate support managers and provide equipment maintenance, administrative, and civil engineering support to all Loran-C facilities in their purview.

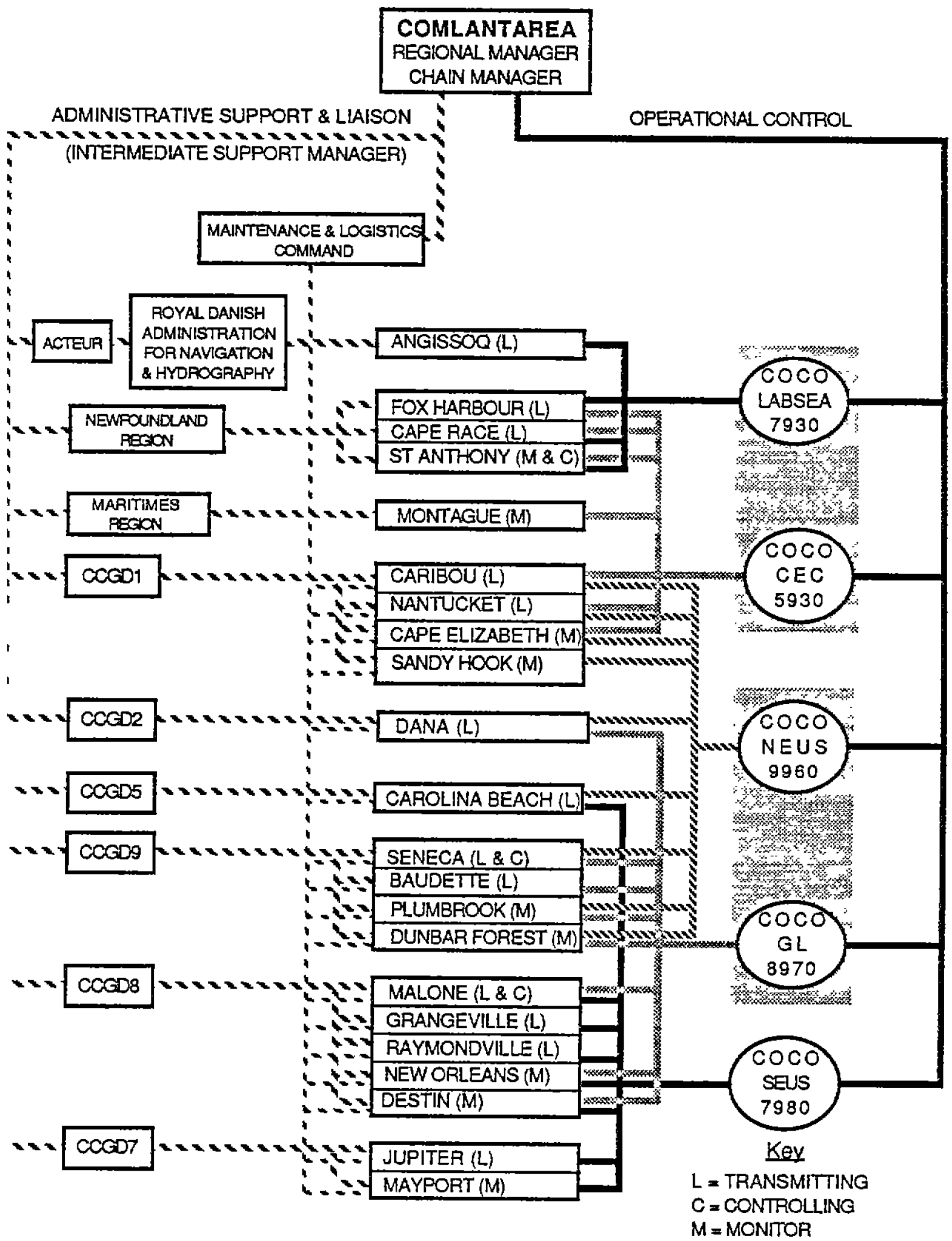
(4) Coordinator of Chain Operations (COCO). To provide effective Loran-C service, it is essential that the operation of each Loran-C chain be supervised closely. For this reason, a Coordinator of Chain Operations for each Chain is assigned. The COCO, acting as the direct representative of the Chain Manager and responsible for the immediate day-to-day supervision of the chain, has broad authority over operations performed at all individual stations of the Chain. The COCO is an officer assigned to duty directly under the command of the Chain Manager and ussually stationed somewhere other than the offices of the Chain Manager. The COCO's duty station is typically at a Loran-C monitor station (LORMONSTA) or Loran-C transmitting station (LORSTA).

3. Duties and Responsibilities.

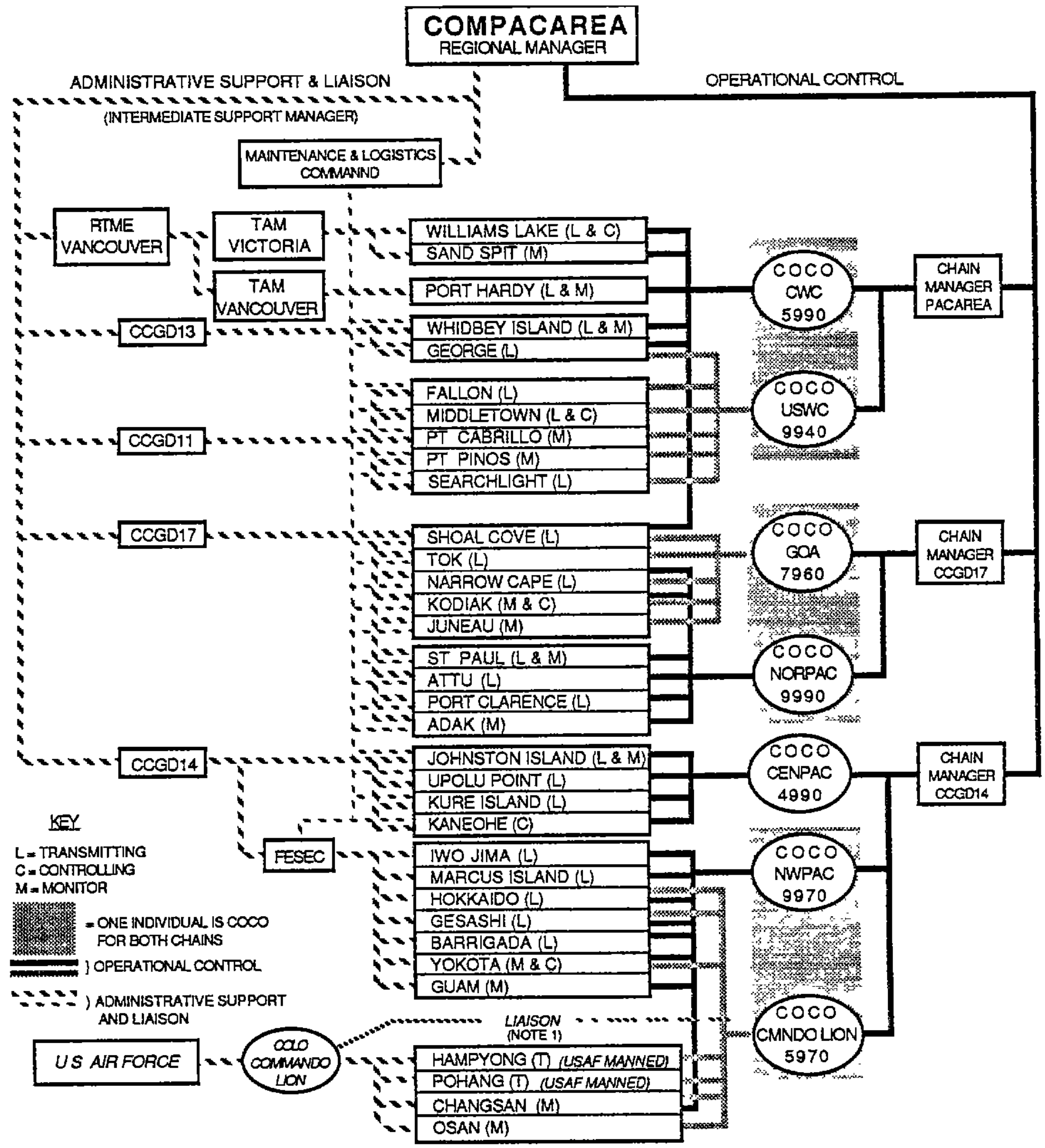
a. Introduction. The management, supervision, or accomplishment of every functions which must be performed within the Coast Guard to operate and support the Loran-C system is assigned below. Coast Guard and host nation operated Loran-C chains span vast geographic areas. Each chain requires unique instructions in addition to instructions common to all chains. The guidance contained herein is common to all Coast Gaurd Loran-C chains and host nation-manned stations as agreed to by agreement or treaty. Questions or contradictions which develop should be resolved at the lowest possible working level. Coordination, assignment, and discharge of functional



Loran-C Command and Control for
Coast Guard Activities, Europe (ACTEUR).



Loran-C Command and Control for Coast Guard Atlantic Area Command (COMLANTAREA).



Command and Control for
Coast Guard Pacific Area (COMPACAREA).

2.B.3. a. (Cont'd) responsibilities for foreign agencies and their subordinate orgainizations will be effected through appropriate intergovernmental agreements. A designated Coast Guard operational commander serves as the coordinating link between the Coast Guard and each foreign operating agency. Certain system control functions must be performed through direct channels of communication which may bypass the normal Coast Guard chain of command or cross boundaries of national authority. For this reason, these functions and the authority to perform them are carefully defined and assigned. Establish procedures ensure that both cognizant Coast Guard command levels and foreign operating agencies are informed promptly of any unusual conditions.

b. Program Manager (PM) Responsibilities. The Program Manager's (G-NRN) responsibility is the effectivie operation of the Loran-C system. In order to ensure this operation, the PM shall:

(1) Develop and administer a program to ensure operation of the Loran-C system. Provide direction, procedures and guidance necessary to support the Loran-C system.

(2) Review and evaluate the performance of Loran-C chains and stations. Initiate action to correct or improve operations as necessary, and obtain adequate funding for the Loran-C program.

(3) Coordinate Loran-C matters with U.S. and foreign Government agencies.

(4) Advise Loran-C users of interference or other abnormal events when they have been evaluated and confirmed by the Regional Manager.

c. Support Manager (SM) Responsibilities. The Support Manager (G-TES) is responsible for the electronic engineering support of the Loran-C system. To ensure this support, the SM shall:

(1) Initiate and review requests for new equipment, or modifications to existing installations. Prepare the budget justification for funds.

(2) Review and prepare plans for construction or modification of Loran_C chains or stations.

d. Regional Manger (RM) Responsibilities. The Regional Manager shall ensure the operation of an effective Loran-C system within an assigned geographic area. The two Area Commands and Commander, Coast Guard Activities Europe are the Regional Managers of the Coast Guard Loran-C system. To ensure this operation, the RM shall:

(1) Develop and administer a progam for the operation of all Loran-C chains within the assigned area of responsibility.

(2) Review and evaluate the performance of Loran-C chains and stations within the RMs area of responsibility and initiate action to correct or improve operations as necessary.

2.B.3.d. (3) Coordinate Loran-C matters with foreign Government agencies who operate and maintain Loran-C transmitting stations, monitor stations, and monitor sites (LORMONSITE) in conjuction with the U.S. Coast Guard.

(4) Coordinate with the user community whenever a change in status of a Loran-C chain is expected to affect the operations of vessels, aircraft or other Loran-C users in the Area.

(5) Ensure the users are notified of unusuable time.

(6) Administer a program for the inspection of Loran-C stations and sites. U.S. Coast Guard Loran-C stations shall be inspected as necessary to ensure uniform operation throughout the RM's area of responsibility.

(7) Coordinate and schedule routine equipment and tower maintenance requiring unusuable time and involving more than one Chain Manager (CM).

(8) Initiate and review requests for new equipment, or modifications to existing installations, and furnish justification for funds if appropriate.

(9) Review plans for construction or modification of Loran-C stations and associated structures and equipment.

(10) Certify new or major changes to Loran-C stations, sites, or chains.

(11) Administer the Operational Performance Award Program for all Loran-C chains within RM's area of responsibility.

(12) Investigate reports of inference or other obnormal events.

(13) Visit host nation-operated Loran-C stations as necessary. Encourage routine inspections by host nation technical personnel.

(14) Provide guidance and assistance to the CMs and their subordinate units when necessary to assure proper operation and maintenance.

(15) Provide timely information to the Program and Support Managers pertaining to operational or support objectivies, planning, programming, and budgetary administration.

(16) Coordinate Loran-C operations of dual-rated stations operating in chains which have different CMs.

(17) Prepare and submit a quarterly Loran-C operations report to Commandant (G-NRN).

(18) Review and analyze data from the monthly report of Loran Operations Information System (LOIS).

2.B.3.d. (19) Develop a Control, Communications, and Monitor Plan (CCMP) for each Loran-C chain. The CCMP shall be reviewed and updated annually and when any major changes are made to the chain.

e. Chain Manager (CM) Responsibilities. The Chain Manager is responsible for the operation of an effective Loran-C chain. To ensure this operation, the CM shall:

(1) Develop and administer a program for the operation of all Loran-C stations within the chain.

(2) Review and evaluate the performance of each Loran-c station and the chain as a whole. Initiate action to correct or improve operations as necessary.

(3) Coordinate with users whenever a change in status of the chain is expected to affect the operations of vessels or aircraft in the area.

(4) Ensure notifications of unusable time are issued.

(5) Coordinate, schedule, and authorize routine equipment and tower maintenance which may result in unusable time.

(6) Initiate and review requests for new equipment, or modifications to existing installations, and furnish justification for funds if appropriate.

(7) Review plans for construction or modification of Loran-C stations and associated structures and equipment.

(8) Review and analyze data from the monthly Loran Operations Information System (LOIS) reports submitted by the COCOs.

(9) Identify and initiate action to correct any procedural or technical fault within the chain which may degrade operational performance.

(10) Inspect Loran-C stations within the chain at least semi-annually if Coast Guard-manned, or visit annually if host nation-manned. Personnel training, operational procedures, equipment operation, and technical support should be sufficient for optimum performance.

(11) Ensure synchronization of each chain to UTC. Monitor and plot the frequency standard offsets and issue corrections to the Master Operate Oscillator. Responsibility for the Master Operate Oscillator may be delegated by the Chain Manager to the COCO.

(12) Investigate complaints of interference or other obnormal events.

2.B.3.f. COCO Responsibilities. The Coordinator of Chain Operation (COCO), or the alternate while acting COCO, is responsible for close day-to-day supervision of the Loran-C chain. The COCO id the direct representative of (and responsible to) the Chain Manager. The COCO has broad authority over the functional operations performed by all elements of the chain. To meet these responsibilities, the COCO shall:

(1) Develop and administer a program for operation of all Loran-C stations within the chain.

(2) Review and evaluate the performance of the Loran-C chain and stations within the chain.

(3) Coordinate with users whenever a change in status of the chain is expected that may affect the operations of vessels or aircraft in the area.

(4) Initiate action to correct or improve operations as necessary, or make recommendations to the CM if the action requires a higher authority.

(5) Ensure the users of the chain are notified of unusable time.

(6) Inspect Loran-C stations or sites within the chain for adequate equipment operations, and watchstander and technican training. Inspections should be made twice yearly.

(7) Coordinate the scheduling of routine equipment and tower maintenance which may require unusable time.

(8) Initiate and review requests for new procedures, or equipment modifications to existing installations.

(9) Gather and analyze the data necessary to prepare the monthly report of Loran-c Operations using the LOIS data base. Compare the report to previous reports and forward it to the RM via the CM with appropriate comments.

(10) Examine all reports of Loran-C station operations and message traffic daily for reports of unsuable time. Report immediately any serious technical or logistical Problem the CM.

(11) Resolve questions about blink periods, passage of control, or other operational procedures.

(12) Be aware of the status of all chain communication cappabilities.

(13) Schedule tests of equipment and personnel to ensure proper performance.

(14) Be aware of all ancillary factors that might impact on the operational performance of the chain.

2.B.3.f. (15) Review daily the station's reports of operations and evaluate the data to determine if performance is satisfactory. Ensure the reports are corrected or confirmed by the originator whenever data appears questionable.

(16) Supervise the entry of LOIS data and ensure completeness and accuracy.

(17) Maintain plots of significant operational system and equipment parameters.

(18) Investigate and report complaints of interference or other abnormal events.

(19) Maintain records of unusable time or other abnormal events to detect trends. Prepare investigative reports as required.

(20) Monitor an plot the frequency standard offsets and issue corrections to all frequency standards with the exception of the Master Operate Oscillator. Responsibility for the Master Operate Oscillator may be delegated to the COCO by the Chain Manager.

g. COCO Qualification. The Coordinator of Chain Operations should have the following qualifications:

(1) A working knowledge of Loran-C operations and a general understanding of Loran-C equipments.

(2) Be familiar with the daily routine of the Loran-C station, its performance, and abnormal conditions. Know procedures for collection and reporting required data.

(3) Know and understand the functional characteristics and performance standards of Loran-C equipment, front panel displays, and controls.

(4) A functional understanding of cesium frequency standards, its meter readings and the method of inserting a frequency change.

(5) Know the functional flow of primary and redundant signals through the timing and monitoring equipment.

(6) Know the cause of and required response to all alarms.

(7) Understand the timing parameters and time reference measurements. Know the time reference measurements for all stations in the chain.

(8) Understand the functional characteristics of the timing equipment.

(9) Understand pulse shape and how it is adjusted.

2.B.3.g. (10) Know the basic signal flow through the transmitter, important voltage and current readings, important adjustments and their impact on the transmitted signal if not properly adjusted.

(11) Know the basic signal flow within the receiving equipment and how to read and interpret time-difference outputs and meter readings.

(12) Understand transmitter and receiver front panel controls, re-locking methods and interpretation of meter readings as appropriate.

(13) Know the major transmitter and receiver alignments, how often they are performed, and the allowed error.

(14) Know how to perform and interpret the major receiver error tests.

(15) Understand the appropriate receiver and recorder calibration procedures.

(16) Understand the use of wave analyzers, spectrum analyzers, and frequency selective voltmeters in interference monitoring, and maintain a record of the most recent interference spectrum at each monitor station.

h. Transmitting Station Commanding Officer Responsibilities. The Commanding Officer (CO), Station Manager, of Officer-in-Charge (OIC) of a transmitting station (hereafter referred to as CO) is responsible for the day-to-day operation of the Loran-C station. The mission of the transmitting station is to transmit continuous, reliable signals that meet signal specification and timing criteria. The efforts of assigned personnel are in support of this mission. The Commanding Officer is assigned to manage the unit and provide positive leadership in performing the stastion's mission. The CO is expected to use experience, education, and military authority to accomplish this mission. A lack of technical training in electronics, or the presence of technically trained electronics personnel, does not change the CO's responsibility. The regulations applying to the Commanding Officer of any Coast Guard unit are contained in Coast Guard Regulations, COMDTINST M5000.3. The principal duty and responsibility of the CO is to ensure that the mission of the station is met. In carrying out these responsibilities the CO shall:

(1) Develop and administer a program to poperate Loran-C equipment on the station. Maintain frequency standard, timing, transmitting and associated auxiliary equipment, and station equipment such as generators and air conditioners, to meet the mission requirements.

(2) Review and evaluate the performance of the Loran-C equipment and systems on the station.

(3) Coordinate with the controlling station and COCO whenever a change in status of the station is expected.

2.B.3.h. (4) Initiate immediate action to correct equipment failures or improve operations.

(5) Conduct Loran-C operations in accordance with this Manual, RM, CM, and COCO instructions.

(6) During abnormal situations coordinate with the controlling station as necessary to regain the assigned parameters utilizing emergecy procedures set forth in section 2.D of this Manual.

(7) Coordinate and schedule with COCO equipment and tower maintenance which may result in unusable time.

(8) Submit datat to COCO on a routine basis for preparation of the necessary Loran-C reports.

(9) Report to COCO instances of interference or other abnormal events.

(10) Develop and maintain a training program to ensure that the technical and watchstanding abilities of personnel are adequate for their Loran-C duties.

(11) Certify the technical and watchstanding personnel in their Loran-C duties and responsibilities.

(12) The Senior Technical Officer, if assigned, will be designated in writing.

(13) Personally conduct weekly inspections to ensure:

(a) All antenna connections are good, couplers are properly sealed, and that there is no audible or visible arcing at the coupler or antenna.

(b) Required preventive maintenance is being performed.

(c) Cleanliness of the electronics equipment.

i. Control Station Responsibilities. The CO of a control section is responsible for the continuous control of the chain. The control station continuously monitors the signals and parameters of the transmitting stations. Station personnel shall take action as outlined in this Manual and RM, CM, and COCO instructions to correct any out-of-tolerance (OOT) condition(s) and return the Loran-C system to proper operation. Depending upon the situation, the control station may be a LORSTA or MONSTA. In fulfilling these responsibilities the CO shall:

(1) Develop and administer a program to operate Loran-C equipment on the station. Review and evaluate the performance of the Loran-C equipment and systems on the station.

2.B.3.i. (2) Coordinate with COCO whenever a change in status of the station is expected which will put the chain at risk.

(3) Initiate immediate action to correct or improve opearations and equipment failures.

(4) Conduct Loran-C operations in accordance with this Manual and RM, CM, and COCO instructions.

(5) Submit data to COCO on a routine basis for preparation of the necessary Loran-C reports.

(6) Report to COCO instances of interference or other abnormal events.

(7) Conduct a training program to ensure the technical proficiency and watchstanding abilities of assigned personnel.

(8) Certify technical and watchstanding personnel in their Loran-C duties and responsibilities.

(9) Monitor and record observed Loran-C time differences of all assigned master-secondary baselines. Monitor ECD of each assigned transmitting station. Maintain the transmitted signal within assigned tolerances.

(10) Assist stations as necessary in regaining their assigned parameters.

(11) Designate the Senior Technical Officer in writing.

(12) Conduct weekly inspections to ensure:

(a) All antenna connections are good, couplers are properly sealed, and that there is no audible, or visible arcing at the coupler or antenna.

(b) Required preventive maintenance is being performed.

(c) Cleanliness of the electronics equipment.

j. <u>Monitor Site Maintenance</u>. The CO of a station may also be responsible for the maintenance of a Loran Monitor Site (LORMONSITE). In fulfulling these responsibilities, the CO shall:

(1) Develop and administer a program to maintain the monitor site equipment.

(2) Initiate action to correct equipment failures.

(3) Coordinate with the controlling station and COCO when a change in status or maintenance occurs that may result in the Loran monitor site being unavailable for chain control.

2.B.3.j. (4) Report to COCO instances of interference or other abnormal events.

k. Senior Technical Officer (STO) Responsibilities. The Senior Technical Officer (STO) is the senior technician on the station, and shall assist the CO as necessary in enforcing regulations. The STO may succeed temporarily to command of the unit, in accordance with Coast Guard Regulations (COMDTINST M5000.3, series). Senior Technical Officers and senior enlisted technicians are assigned to Loran-C stations for the specific purpose of providing high level technical expertise and shall not be assigned duties as executive officers, or executive petty officers, respectively. Where an STO is not assigned, the CO shall perform the STO duties. The STO or senior technician duties shall include:

(1) Directing the operation, maintenance, and electronic engineering functions of the Loran-C station.

(2) Inspection of the electronics equipment, spaces, safety devices, and ensure correction of deficiencies.

(3) Observation and correction of the performance of Loran-C station personnel.

(4) Review of all logs and reports required for Loran-C operations, maintenance, and engineering.

(5) Advising the CO on technical aspects of the station operations and on the performance of personnel.

(6) Conducting training for station personnel in maintenance, support functions, and operating procedures of the Loran-C communications, and auxiliary electronic equipment.

l. Duty Electronics Technician Responsibilities. The primary responsibilities of the Loran-C Duty Electronics Technician (ET) are to correct any casualty situation that is beyond the capabilities of the watchstander. If the casualty is beyond the ET's capability, the station STO or senior technician shall be notified. The ET shall also perform minor corrective maintenance to electronics equipment. Specific responsibilities of the Duty ET are:

(1) Have a thorough working knowledge of this Manual and all pertinent directives.

(2) Possess a thorough working knowledge of the station's Loran-C and communications equipment.

(3) Initiate immediate correction of any casualty situation that is beyond watchstander capabilities.

2.B.3.1. (4) Perform corrective maintenance to electronics equipment to restore normal operation. The Duty ET will not work on any equipment where hazardous voltages are present without one or more personnel trained in cardio-pulmonary resuscitation (CPR) standing by. Safety procedures contained in Electronics Manual, M10550.1 (series) and Coast Guard Regulations, M5000.3, will be strictly followed.

(5) Notify the STO of the following conditions:

(a) When any signal irregularity exceeds five minutes, or

(b) when casualty situation is beyond the capabilities of the Duty ET, or

(c) when failure occurs to any part of the station's Loran-C system.

(6) Perform other duties as assigned.

m. Transmitting Station Watchstander Responsibilites. The responsibilities of the transmitting station watchstander are to monitor and maintain the basic parameters of operation, and correct any discrepancy or deviation from normal operation. If unable to correct a discrepancy or casualty, the watchstander shall notify the proper authority immediately. Specific responsibilities of the watchstander are:

(1) Monitor all local parameters and make adjustments as necessary to maintain parameters within the assigned tolerances.

(2) Insert timing corrections as directed by the controlling station or COCO.

(3) Take immediate action to correct any casualty condition affecting the transmitted signal.

(4) Notify the Duty ET when:

(a) any Loran-C equipment casualty occurs, or

(b) any condition arises that is beyond the watchstander's capabilities to correct, or

(c) a signal irregularity to the station baseline has existed for more than two minutes.

(5) Unwatched mode is where a watchstander is on board within range of all audible alarms, but not required to remain in the operations area. At stations that operate in the unwatched mode, the watchstander shall perform the tasks listed below:

(a) Mark charts in accordance with section 2.C.

2.B.3.m. (5) (b) Perform check-in in accordance with section 2.C.

(c) Ensure all alarms are functioning properly.

(d) Ensure proper relief in accordance with section 2.E.4.

(6) At stations operating in the watched mode, the watchstander shall:

(a) Mark charts in accordance with section 2.C.

(b) Enter adjustments as directed by the control station.

(c) Continuously monitor all communication channels assigned for Loran-C control.

(d) Ensure proper relief in accordance with section 2.E.4.

(7) Remote Operating System (ROS) stations normally operate in the unattended mode. Int eh unattended mode, a continuous 24 hour watch is not maintained. Maintenance personnel are normally onboard during normal working hours and in response to emergencies requiring an on-board watch or corrective maintenance. The transmitting station watchstanding responsible for the baseline shall:

(a) Perform all tasks in (5) above.

(b) Ensure recall equipment is programmed and operating properly.

(c) Ensure the control station has correct recall information (e.g., who's on recall, correct phone number).

n. Control Station Watchstander Responsibilities. The primary responsibility of the control station watchstander is to provide transmitting stations with information and to assist them in the transmission of Loran-C signals within prescribed tolerances. Specific watchstander responsibilities are:

(1) Continuously monitor the relative timing between master and secondary station signals using all available monitor information and using any information provided by the transmitting station, Precise Time and Time Interval Monitor, or other available sources.

(2) Issue phase adjustments to secondary stations in accordance with section 2.C to compensate for any offset between the master station frequency standard and secondary station frequency standard.

(3) Mark charts in accordance with section 2.C.

2.B.3.n. (4) Provide information as needed during casualties to help transmitting stations return signals within prescribed tolerances.

(5) Ensure that control information si passed in a timely manner using any available means of communication.

(6) Verify Primary Chain Monitor Set (PCMS) printout to chart correlation at the beginning of each watch period.

(7) Ensure that a complete briefing is given to the relieving watchstander.

(8) Notify the senior watchstander and STO in accordance with station instructions when signal irregularities occur.

(9) Notify the Duty ET in accordance with station instructions when any equipment fails to meet minimum standards during routine checks or exhibits abnormal symptoms.

(10) Use the ROS to recover from a Loran casualty. Notify the transmitting station duty technician of station alarms that require their attention.

o. Watchstander Qualification and Certification. Transmitting stations shall have a training program designed to qualify new personnel as Loran-C watchstanders and duty technicians. COCOs shall periodically review these programs to ensure the content and procedures are correct. When the individual qualifies, the CO shall certify qualification in writing. File copies of certifications for personnel shall be made available upon request by appropriate personnel. For Coast Guard personnel, a copy of this certification shall be filed in their service record. On Coast Guard operated stations, COs are encouraged to consider the use of non-electronics personnel as Loran-C watchstanders.

4. Other Entities.

a. Host Nation Operated Stations. Regional Managers of chains which include Host Nation operated stations shall coordinate all Loran-C matters with the foreign operating agencies. They oversee the operation of those direct lines of communications which must cross boundaries of national authority to permit the effective discharge of functional responsibilities necessary to operate the Loran-C system. The RMs also ensure the effective flow of communications between the foreign agencies and the Coast Guard. The Host Nation operated stations are assigned all of the operational functions and responsibilities assigned to a comparable Coast Guard station. The command and administrative support of Host Nation operated stations is the responsibility of the cognizant foreign agency. The responsibility and authority required to effect the operational responsibilities is established by appropriate intergovernmental agreements.

2.B.4.b. Contractor Maintenance. Several unstaffed monitor sites are now maintained by entities other than the Coast Guard. Total or partial contractor maintenance and operation of other Loran facilities is possible. In such cases contractual specifications will be drawn for each facility on a case-by-case basis because of the differences between the facilities. Further discussion about this is beyond the scope of this manual.

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2.C. **Normal Loran-C Operations**.

1. General.

    a. Introduction. In the following sections, instructions for non-causalty Loran-C operastions are discussed. Specific areas addressed are: Control Station Operations, Transmitting Station Operations, Monitor Site Operations, Remote Operating System Operations, and Precise Time and Time Interval measurement and control conventions. Loran-C operations may be broadly defined by two functions: generate electromagnetic Loran-C signals by the trasnsmitting station, and precise timing of the signals by the control station. Loran-C operations deal with three major aspects of these two functions. These three aspects can be categorized by their time occurrence: normal real-time operations, equipment casualty or other abnormality recovery procedures, and long-term analysis and management of operations. Normal real-time operations are ensured by proper equipment maintenance at each transmitting station. Signal quality is maintained within tolerance by control station and transmitting station monitoring. Casualty recovery (discussed in section 2.D) is principally performed by the transmitting station assisted by the contyrol station. Long-term analysis is based on station daily operations reports (discussed in section 2.E). The report data are analyzed, processed, and acted upon by the COCO, CM, and RM.

    b. Monitor Assignment. In order to ensure the stability and accuracy of the system, monitor sites (designated Alpha-1 and Alpha-2, primary and secondary sites respectively) and control stations are assigned by the Program Manager. Based on these assignments and communications circuits, the RM issues instructions to each Loran-C chain, and determines the priority of alternate methods of control, monitoring, and communications.

    c. Loran-C Functions and Constants. The operational functions and constants for Loran-C chains within an operational area are assigned by the Program Manager. The Aids to Navigation Annex to the Regional Manager's Standard Operating Procedure (SOP) and Regional Manager's Supplemental Instructions (RMSI) contain station names, functions, positions and emission delays, rate, control method (in order of priority), Controlling Standard Time-difference (CSTD), Controlling Standard Envelope to Cycle Difference (CSECD), and tolerances. These specific assignments may be updated, as required, by evaluating long-term effects of the present control values, and by requesting the Program Manager to approve and issue changes.

2.C.1.d. Chain Control Parameters. The purpose of chain control parameters is to ensure the integrity of the signals within the published service area. A fundamental requirement of control is to measure the value of selected parameters to ensure that the values established and assigned by the Program Manager are maintained. The three basic parameters to be monitored are:

(1) Time-Difference (TD). Baseline TD's are continuously monitored and are maintained near the Controlling Standard Time-difference (CSTD) by inserting local phase adjustments (LPAs). In general, the difference between the hourly average of TD and CSTD is not allowed to exceed 50 nanoseconds.

(2) Envelope-to-Cycle Difference (ECD). ECD is the time relationship between the phase of the RF carrier and the time origin of the envelope waveform. Short-term control of the ECD is achieved by the transmitting station maintaining its transmitted ECD to within 0.5 microseconds of the currently assigned value of the Electrical Pulse Analyzer (EPA) ECD. Long-term control of ECD is based on measurements made at the monitor site and LORSTA. Adjustments to the transmitting station ECD assignments are made such that the ECD at the monitor location is held to the Controlling Standard ECD (CSECD) within the tolerance specified (normally < 1.5 microseconds). Thus, there are three important definitions which apply to ECD control:

(a) CSECD. Controlling Standard Envelope-to-Cycle Difference at a primary monitor site, determined during baseline calibration and specified by the Program Manager. See 2.C.3.c. (2).

(b) Assigned ECD. The current ECD assigned by COCO at a transmitting station as displayed on the EPA. See 2.C.3.c. (2).

(c) Nominal ECD. The ECD obtained by making measurements of the individual half-cycles and determined analytically by using the current version of the Loran Operations Information System (LOIS) Minimum Mean Square Error (MMSE) program. The nominal ECD is assigned by the Program Manager. See 2.C.3.c.(2).

(3) Peak Radiated Power (PRP). Output power is monitored at each transmitting station by measurement of the zero-to-peak current on the ground return line from the Loran-C antenna.

2.C.2. Control Station Operations.

a. Introduction. The control station has receiving equipment, sometimes located remotely at monitor sites, that continuously mpnitors the time-difference between the received master and secondary station transmissions. The control station issues local phase adjustments (LPAs) to the secondary station to compensate for any frequency offset between the master and secondary operate oscillators and propagation variations. These adjustments maintain the phase time-difference near the assigned CSTD. The control station functions as a real-time monitor of each transmitting station to ensure that equipment casualties have not rendered either the timing or other characteristics of the signal unusable. The control station's monitoring equipment normally consists of a CDFO-5000A Loran-C Monitor receiver, strip chart recorders, communications equipment and a calculator assisted Loran-C controller (CALOC).

(1) CDFO-5000A Loran-C Monitor Receiver. The CDFO-5000A receiver shall be operated only with the authorized version of software, as specified by the Support Manager. The only exception shall be for authorized field tests. The Loran-C monitor receivers may be remote from the control station, but located within the service area.

(a) Alpha Receivers. Primary CDFO-5000A receivers shall be operated with settings as follows:

1. Time-difference Nominal (TDN): CSTD.

2. Envelope Nominal (EN): CSECD.

3. Time-difference Deviation (TDD): < tolerance.

4. Envelope Deviation (ED): < tolerance.

5. CLIP: ON (clip = 1).

6. Gain Deviation (GD): < 6.

7. Out: as established by COCO.

8. ZERO: set so CSTD and CSECD produce center scale recorder readings.

9. TMCN: 400 (COCO may authorize changes)

10. AVG: 2 (COCO may authorize changes)

Exceptions to these settings are allowed during signal irregularities when other settings may be appropriate as directed by COCO.

2.C.2.a. (1) (b) Alpha-2 CDFO-5000A Receivers. Secondary CDFO-5000A receiver channels shall be operated with settings established by the RM, CM or COCO.

(c) Settings. Operating settings for both Alpha-1 and Alpha-2 receivers will be published by the RMs in RMSI or SOP.

(d) CAL Mode. The CDFO-5000A receiver shall be placed in CAL mode and tested or calibrated at least once per week. Changes to Envelope Number Correction (ENVCR) must be authorized by the COCO. Allowable errors are:

1. Gain: <1 dB.

2. ECD: <0.1 s.

3. TD: <10 ns.

(2) Chain Recorder Set (CRS).

(a) Zero - Full Scale Calibration. Alpha-1 CRS recorders shall be set up with CSTD and CSECD at mid-scale and aligned in accordance with the PCMS technical manual instructions. Calibration of the recorder system shall be checked once a week to verify zero and full scale indications on the strip chart recorders. If the calibration check and adjustment fails, the CDFO-6019(D) strip recorder shall be placed in maintenance. Alpha-2 recorders will be calibrated in the same manner using assigned Alpha-2 values. Calibration procedures shall be incorporated in the unit SOP.

(b) Teleprinters. Teleprinters shall be maintained in accordance with the technical manuals. Contrast should be periodically adjusted as required to maintain readability. If adjustments fail to produce legible copy, the teleprinter shall be placed in maintenance.

(c) Patch Panels. Patch panels shall be maintained in accordance with the technical manual. Modifications to patch panel wiring or configuration may be authorized only by the RM.

(3) System Sample. The system sample is the data source for LOIS. The system sample consists of hourly averages taken concurrently at all stations within the chain during a daily one-hour period (system sample period) as specified by COCO (typically during midday). Additional information on system sample data can be found in section 2.E.3.d. (2). COCOs shall coordinate system sample times for dual rated stations to ensure concurrent sampling.

2.C.2.b. <u>Calculator Assisted Loran Controller (CALOC)</u>.

(1) The CALOC system consists of a desk top calculator, printer, plotter, and Current Loop Interface (CLIF) to receive and process data from the CDFO-5000A receivers. It computes optimum LPAs, and performs log keeping. It functions to relieve the control station watchstander of many tedious and routine tasks and to perform several mathematically based operations more accurately. CALOC is not intended to supplant or replace the subjective judgment of the watchstander. The CALOC system provides control direction for up to four baselines and is designed to work with the Primary Chain Monitor Set. The CALOC system monitors and controls the TD, and monitors the ECD of the signal.

(2) <u>CALOC Operating Modes</u>. CALOC may be operated in any of three modes as determined by COCO:

(a) <u>Automatic</u>. The CALOC automatically calculates and inserts LOSa as required to maintain CSTD. This is the preferred mode of operation. To allow the secondary receiver (Alpha-2) to be used for control, CALOC automatically calculates a correlated number used to maintain CSTD at the ALpha-1 monitor site. The CALOC also produces a plot showing TD error (TDE), LPAs, monitor changes and Maintenance Phase Adjusts (MPAs). Additionally, CALOC automatically logs some receiver alarms, LPAs and monitor changes and provides the capability to insert operator comments in the log.

(b) <u>Semi-Automatic</u>. The CALOC plots and logs information as in automatic mode, but LPAs are recommended instead of automatically being inserted. The program waits for the watchstander to make a determination whether or not to insert the LPA.

(c) <u>Manual</u>. The CALOC plots and logs information as in automatic mode. The LPAs are calculated and recommended but the program does NOT halt. Unless the CM directs otherwise, CALOC will not be operated in the manual mode for longer than 24 hours.

(3) <u>CALOC Software</u>.

(a) <u>Authorized Software</u>. The CALOC shall be operated only with the authorized version of software as specified by the Support Manager. The only exception shall be for an authorized field test.

2.C.2.b. (3) (b) Ki and Ks Parameters. The weighting factors KI and Ks determine the amount of effect that the TD error and the cumulative TD error will have on LPA recommendations. The COCO may, by changing these factors, produce different control behavior. This is described in detail in the CALOC technical manual.

(c) Control Policy (CONPOL). Two sets of weighting factors and LPA insertion intervals are stored in CALOC memory. The Control Policy (CONPOL) determines what time of day each Ki and Ks parameter set will be used. CALOC contains two CONPOLs and the times they are to be in effect. The COCO is authorized to set CONPOL times as required to obtain best performance. The COCO shall check CONPOL times and Ki and Ks values at least quarterly and changes shall be noted on the Monthly Report of Loran-C Operations.

3. Transmitting Station Operations.

a. Introduction. Although transmitting station equipment and staffing levels vary widely, each station transmits a precisely timed and shaped series of Loran-C pulses of sufficient power to provide advertised coverage. Monitoring equipment at each transmitting station permits important local amd remote signal characteristics to be continuously measured and monitored. These measurements are used in two ways. First, when reported on a regular basis to COCO, they can identify problem areas or trends. Second, if a casualty occurs, they provide information for the watchstander to use to return to normal operations.

b. Control.

(1) Modes of Control. There are four modes of baseline control: Alpha, Bravo, Charlie and Delta. At the transmitting station, only Bravo, Charlie, and Delta modes of control are used. Control stations with ROS equipped stations also have the capability of assuming these forms of control remotely. Baseline control at the transmitting station is intended for short-term control only. Refer to section 2.D. for additional information on the various modes, their priorities, method of transfer, and how to establish a correlated number.

(2) Baseline Control. From time to time, the transmitting station may be required to take control of a baseline. There are a number of reasons why this may occur; e.g., equipment failure at the control station, communications link failures from the monitor sites, or equipment failure at the transmitting station. Control is always of the baseline, not just the station.

2.C.3.b. (3) Baseline Responsibilities. When taking control of a baseline, a transmitting station shall be responsible for the following:

(a) Controlling TD. Although a transmitting station does not measure actual TD, a measurement akin to TD called Time Interval Number (TINO) is available using locally generated timing references. When in local control, the transmitting station inserts LPAs to maintain TINO. See section 2.C.3 for further information.

(b) Secondary Blink. Starting and stopping secondary blink in the event of a parameter being out-of-tolerance at either the master or secondary station.

(c) Watched Mode. Remain in a watched mode of operations until control is taken by another station.

(d) Return to Alpha Control. The baseline returns to Alpha control when directed by the control station. If control was shifted due to a casualty and the signal characteristics observed at the control station are stable, control shall be returned to Alpha. The signal need not be in-tolerance for the control station to accept control.

(e) ECD Control. ECD adjustments can only be made by transmitting station personnel during local control. The control station watchstander monitors ECD and initiates blink when CSECD is exceeded; but, cannot make ECD adjustments.

(f) Equipment Switching. Transmitting Stations in local control shall not switch equipment unless it is necessary to maintain signal parameters in tolerance or to perform necessary preventive maintenance. Unnecessary equipment switching must be avoided.

c. Monitored Signal Characteristics.

(1) Transmitted Power (Vp).

(a) Pearson Current Transformer. Each station has a Pearson current transformer in the Loran-C transmitting antenna's ground return line. The transformer delivers a current to a 100 Ohm load of 0.1 volt/ampere. This signal (Operate RF) is provided to the EPA which measures and displays the zero-to-peak voltage (Vp) of each Loran-C pulse.

2.C.3.c.(1) (b) EPA Digital Panel Meter (DPM) Calibration. Transmission losses between the Pearson transformer and the EPA will vary from station to station. The EPA DPM must be calibrated to reflect the output of the transformer. An initial calibration is done at the time of installation. Follow-on calibrations of the DPM will be done at six-month intervals or when the calibration is suspect. Each such calibration shall be reported to COCO. Refer to the EPA technical manual for the procedure to be used.

(c) Required Vp. Each transmitting station must meet the transmitted power requirements specified in the Signal Specifications. Using either a known or a best estimate of the transmitting tower radiation resistance (Rr), the RM will determine the Vp which must be held in order to meet the required peak radiated power. If a measurement of Rr is made, the RM shall use the new information to confirm the assigned Vp. When the assigned Vp has been determined (or changed based on a new Rr), the RM will establish and promulgate the following:

1. Assigned Vp: Represents the station's rated output as specified in the Signal Specifications. Assigned Vp is determined using the following relationship:

$$Vp = \frac{1}{10}\sqrt{\frac{2P}{Rr}}$$

where Vp - Assigned Vp in Volts
P - Radiated power in Watts
Rr - Antenna radiation resistance in Ohms

where Vp - Assigned Vp in Volts
P - Radiated power in Watts
Rr - Antenna radiation resistance in Ohms.

2. Maximum Vp: The highest Vp value that the transmitter can operate without signal distortion or damage to equipment.

3. Minimum Vp 80% of Assigned Vp.

4. Blink Vp 70.7% of Assigned Vp (half of rated power).

2.c.3.C.(1) (d) Vp Operating Levels. Operation at various levels of Vp require different operational responses as follows:

1. Operations with Vp greater than Maximum Vp are not permitted. The risk of damage to the transmitter is great.

2. Operations with Vp greater than assigned Vp, but less than Maximum Vp are considered normal operations. Stations should be operating in this range routinely.

3. Operations with Vp less than assigned Vp, but more than minimum Vp must be justified to COCO. The COCO shall report justification, with appropriate recommendations, to the DM.

4. Operations with Vp less than minimum Vp, but more than Blink Vp are unacceptable. Action must be taken to correct the problem. Tube-type transmitters shall set the AN/FPN-60 Transmitter Automatic Controller (TAC) to switch at this point.

5. Operations with Vp less than Blink Vp require immediate user notification. Secondary blink on all affected baseline(s) will be initiated immediately. Operations at (or below) this level, without appropriate secondary blink, will be considered "out of tolerance without blink."

(e) Vp Chart Recording. Although Vp during the daily system sample must be reported to the COCO, there is no requirement for a chart recording of this parameter.

(2) Envelope to Cycle Difference (ECD).

(a) General. The ECD measured at each LORSTA is obtained from the transmitting antenna ground return current (Pearson transformer). There are two methods used to obtain ECD: (1) digital display of the ECD on the Electrical Pulse Analyzer (EPA) and (2) calculate the ECD using LOIS. The EPA ECD is used with the Assigned ECD while the calculated ECD is used with the Nominal ECD to maintain the correct transmitted ECD.

1. EPA ECD. The EPA receives the Operate RF signal from the Pearson current transformer and processes it to provide an estimated ECD, half-cycle peak values, and the value of Vp. The value of ECD displayed on the EPA is an average of the ECDs (as determined by the EPA) of two selected pulses in the Loran-C signal. The

2.C.3.c.(2)(a)

1. (Cont'd) master station uses the third pulse of GRI A while the secondary station selects the seventh pulse of GRI A. Both master and secondary stations use the first pulse of GRI B.

2. Calculated ECD. The watchstander uses an oscilloscope to measure half-cycle peak voltages from the Pearson transformer, then calculates the ECD using the LOIS signal shape analysis. The method used to obtain the calculated ECD is the Minimum Mean Square Error (MMSE) estimator. The MMSE program will provide: ECD, half-cycle error and an estimated Vp.

(b) General ECD Requirements.

1. For each station, using the calculated ECD values for each pulse and (where available) information concerning the seasonal variation of ECD, the Chain Manager will determine the value of calculated ECD and primary monitor site ECD necessary to ensure the ECD in the coverage area is within the range of 0 to +2.5 microseconds.

2. These recommended values will be forwarded to the Program Manager. Upon receipt, the Program Manager will assign the "nominal" calculated ECD value (at the transmitting station) and the Controlling Standard ECD (CSECD) for the primary monitor site.

3. Once the "nominal" ECD and CSECD have been assigned, the RM will provide guidance to the COCO and stations on adjustment.

4. The assigned ECD will be determined by COCO and provides a ready indication of the station's transmitted ECD. The COCO will establish the assigned ECD consistent with maintaining the Nominal ECD and CSECD.

5. At Solid-State Transmitter (SSX) stations, the installed equipment automatically adjusts the pulse shape to maintain the desired ECD. At Tube-Type Transmitting (TTX) stations, the pulse shape is built and maintained by the station's technical personnel. Many factors are involved in building a Loran-C pulse. Among these are the setting of the Envelope Timing Adjust (ETA) thumbwheels, pulse generator (PGEN) thumbwheels and gain pot, transmitter adjustments or condition, and others. Since there are many pulse-building techniques, stations shall use the technique specified by the RM.

2.C.3.c.(2)(b) 6. Each transmitting station must have a chart recorder monitoring the EPA ECD. The COCO shall specify the type ECD information that shall be reported on the station's daily operations report.

(3) Droop.

(a) Due to transmitter power supply limitations, the peak values in the pulse group tend to differ. Droop relates the peak amplitude of the largest pulse (Vpmax) of the Loran-C pulse group to that of the smallest (Vpmin) in the same group. Droop is measured in percent and is given by:

$$\%Droop = \frac{Vpmax - Vpmin}{Vpmax} \times 100\%$$

(b) A second parameter of interest is the inter-group droop known as Group Droop. This parameter is particularly important at dual rated stations. The percent Group Droop is calculated using the same formula as percent Droop except Vpmax is the largest pulse peak amplitude in either group and Vpmin is the smallest pulse peak amplitude in either group. Group Droop is measured in percent and is given by:

$$\%Group\ Droop = \frac{Vpmax - Vpmin}{Vpmax} - 100\%$$

(c) Droop is adjusted using the PGEN Droop controls to maintain a droop of 5% or less at single rated stations and 10% or less at dual rated stations. The COCOs shall ensure all stations meet the signal specification criteria for droop. Droop and Group Droop will be measured during the system sample and reported to COCO on the daily operations report.

(4) Timing Numbers. The basic timing numbers used at a transmitting station consist of TINO, LEN, and SYNC. See Table 2-1 for information on how these numbers are obtained and their definitions. These Timing Numbers are used by the transmitting station in casualty recovery operations and, when required, to control the baseline. The COCO shall ensure TINO, LEN, and SYNC are correct at each station.

(a) TINO. The TINO is a pseudo-TD which represents the timing interval between the received reference signal and the timer. The TINO doesn't include the effect of cycle compensation or LEN. The TINO consists of two elements, one coarse, one fine. The coarse element is defined in Table 2-1. The fine element is obtained by making a phase comparison (with a resolution of 20 nanoseconds) of the phase-shifted 1MHZ signal from the

2.C.3.c.(4)(a) (Cont'd) CDFO-2000 receiver against 1MHZ signal from the operate timer. The output of the phase comparator is available and is used to generate a chart recording of phase information. A chart recording of TINO is required at all transmitting stations. Stations will report the TINO's daily system sample average to COCO on their daily operations report.

(b) LEN. The LEN shall be monitored for significant changes. Should such a change be noted, the transmitting station shall identify the cause, take appropriate action, and notify COCO.

(c) SYNC. The SYNC is a function of TINO and LEN (and GRI if a master). If these parameters are proper, SYNC will be correct. Station personnel must check SYNC or LEN in order to ensure proper timing relationships.

(5) Cycle Compensation. The cycle compensation loop compensates for the station local path delays (difference between the time the appropriate signals leave the Loran-C timer and the time the OPERATE RF signal from the transmitter is sampled by the cycle compensation circuit). The local path delay is a sum of transmission line delays, station layout, transmitter delays and transmitter type. The local path delay varies from station to station. A chart recorder for cycle compensation output is available from the timer and will be used. This parameter need not be reported to COCO on the daily operations report unless it exhibits unusual activity. Reasonable movement of cycle compensation is expected when pulse building or switching transmitting equipment components. Any unexplained movement of this parameter must be promptly investigated and the cause corrected.

d. Equipment Configuration.

(1) General. No changes will be made to transmitting station electronic installations without proper approval. Changes will normally be requested through the Electronic Alteration Request (ELECTRONALT) process defined in the USCG Electronics Manual (COMDTINST M10550.13). If operational necessity dictates, the chain manager may authorize changes on an interim basis. However, authority for these changes must be requested, even after the fact, through the ELECTRONALT process.

TINO (Secondary)	NEG CDFO-2000 PC	POS Timer Set PCI	The time interval between the remote signal tracked by the CDFO-2000 receiver and the local Timer Set* time base. This is the Timing Number linking the local
TINO (Master)	NEG Timer Set PC	POS CDFO-2000 PCI	Loran time base clock to the time of should be equal to the emission receipt of the remote signal. TINO delay minus the baseline length (in microseconds) plus approximately 260-410 s at a secondary station and this value plus twice the baseline length (in microseconds) at a master station.
LEN	NEG Timer Set PCI	POS EPA "ENVTRIG"	Time interval between the local time base and a zero crossing of the locally transmitted Loran pulse as monitored on the antenna current line. This is a local delay measurement, reflecting cycle comp, timer and transmitter delays. It should remain a constant value and will range from 550 to 710 s** Add 1,000 s for SSX.
SYNC	NEG CDFO-2000 PCI	PCS EPA "ENVTRIG"	The time interval between the remote signal tracked by the CDFO-2000 receiver and a zero crossing of the locally transmitted Loran pulse as monitored on the antenna current line. It relates the time of receipt of the remote signal.

At a master station: SYNC = (GRI - (TINO - LEN)) = GRI - TINO + LEN
At a Secondary station: SYNC = TINO + LEN

Measurements are algebraically related providing a "closed-loop" check of the timiing relationships and signals radiated at each transmsmitting station.

* AN/FPN-54A or AN/l=FPN-65 depending on the type of transmitter.
** Depends on the type of transmitter installed.

Table 2-1. TCE Time Interval Counter (TIC) Definitions.

2.C.3.d. (2) Blanking. Blanking is the process, on a dual-rated station, of preventing the transmission of one of the rates when groups from both rates overlap. The Program Manager will assign the type of blanking to be used. The chain manager will ensure the stations use the correct blanking scheme. If a change in the blanking scheme is desired, the CM shall submit a request with appropriate justification to the Program Manager.

(3) AN/FPN-44/44A/45 Feedback Modification. This modification installs a feedback loop in the transmitter to optimize transmitter operations. The operation of this feedback loop may obscure transmitter problems. The transmitter may be operated open loop on air (dummy load preferred) to resolve these problems. Short-term (0-24 hours) open loop operations for maintenance purposes may be authorized by COCO. Longer periods of open loop operations must be approved by the CM.

(4) Deenergized Standby Loran Transmitter (DESLOT).

(a) General. For many years, the standby transmitter (on TTX stations) was required to be kept running in an "immediate standby" mode. This was expensive in terms of energy required to keep the standby transmitter costs involved. Using DESLOT, the standby transmitter is not returned on-line as quickly, but the savings in energy costs may far outweigh the impact of slower start up.

(b) DESLOT Determination. The Regional Managers will make the determination whether DESLOT shall be implemented on their stations. Operational needs, cost-savings, etc., vary from region to region and even from station to station. The RM is in the best position to determine if DESLOT is to be used.

(5) Cesium Beam Standards. The cesium beam frequency standards are the time source for the Loran-C system and are delicate electronic instruments. Proper care of these instruments will significantly reduce the risk of unusable time. Their importance to the system cannot be overstated. Environmental requirements, maintenance and operation of the frequency standards will be governed by the appropriate technical manuals and supplemental instructions. The following basic rules shall also be followed:

(a) Master Operate Standard Adjustment. Only the CM (COCO when so delegated by CM) is authorized to issue phase microstepper corrections to the Master Operate standard.

2.C.3.d.(5) (b) Chain Standard Adjustments. Only the COCO is authorized to issue C-field or phase microstepper corrections to all other standards in the chain. In situations where two COCOs (or CMs) share a station, the RM shall designate which COCO has the authority to issue corrections. When two COCOs are involved, the COCO with the issuing authority shall consult with the other COCO before issuing a correction.

(c) Oscillator Configuration. There is no "standard" oscillator configuration in the Frequency Standard Rack. The "Operate" frequency standard may be found in any of the three rack positions. In the event of a failure of either the "Operate" or "Standby" standards, the "Tertiary" shall replace the failed standard. Once the "Tertiary" has assumed the function of the failed standard, it PERMANENTLY assumes that function. When the replacement standard arrives, it shall be designated the "Tertiary" AND WILL REMAIN. ALL CHANGES OF FUNCTION SHALL BE ACCOMPLISHED USING THE PATCH PANEL. OSCILLATORS SHALL BE PHYSICALLY MOVED ONLY WHEN REQUIRED TO INSTALL OR REMOVE A REPLACEMENT OR FAILED STANDARD.

(6) CDFO-2000C Receivers.

(a) General. Two models of the receiver are available. One which permits the identification and reporting (via the appropriate alarm) of the master station's ninth-pulse blink, and one which is used with the two pulse communications (TPC) system. Either model provides an output which is synchronized with phase tracking strobes. This output and a local timing reference from the timers result in a TINO.

(b) Track Point. The receiver is calibrated when installed to establish the proper tracking point on the received Loran-C signal. The same TINO and SYNC numbers should be obtained within ±0.5 microseconds to any receiver installed in place of the original.

(c) Control Settings. The receiver controls shall be maintained as follows:

1. Servo - As determined by COCO
2. Amplitude - LAG, Time Constants as determined by COCO
3. Slave/master switch - As required by station function
4. RF open/gated - Gated

2.C.3.d.(6)(c)

5.	Attenuation	- As needed to place amplitude between "Flag" and "8" when installed. Settings shall not be changed to counter remote signal fluctuations.
6.	Wide/narrow band	- As determined by CM
7.	Bal/Unbal	- Bal
8.	0/180 degrees	- 0

(7) Notch Filters.

(a) General. This section applies to stations with either fixed or tunable notch filters.

(b) Authorization. Insertion of notch filters, if not properly done, can actually be harmful to receiver operations. To reduce this risk to the system, authorization to insert notch filters is vested in the CM. If operational necessity dictates, COCO may authorize this action. However, the CM must be notified as soon as possible following insertion of the notch filter. Specific direction on this matter will be issued by each CM.

(8) Uninterruptable Power Supply (UPS) Battery Checks. All of the backup power sources servicing the timing equipment at a transmitting station are battery powered (when primary power is off). Regular checks of these sources are necessary to ensure backup power will be available when needed. Each of the below equipments will be checked at the period indicated. Each CM will provide detailed direction on how the check is to be done. Checks will be scheduled and performed in a manner which will not place Loran-C operations "at risk."

(a) UPS-501 (or 501-1): Every three months for 15 minutes having an equivalent of a normal load.

(b) CDED-312D: Every three months for 15 minutes having an equivalent of a normal load.

(c) CAQI-5061A: If batteries are installed, each month, one of the three standards is checked for 15 minutes. On successive months, the other standards will be checked. Result: each standard is checked quarterly.

2.C.3.d. (9) Loran-C Transmitter Switches.

(a) General. TTX transmitter switches and SSX Coupler Network switches produce a momentary loss of service to the users. Such switches shall be minimized to those necessary to accomplish required maintenance.
(b) Switching Cycle. TTX stations are may routinely switch transmitters at one or two week intervals to perform preventive maintenance.

(10) Operate and Standby Timers. The uppermost Loran-C timer in the equipment cabinet is referred to as Timer No.1 and shall normally be the Operate (i.e., on-line) timer. The Loran-C timer below Timer No.1 is referred to as Timer No.2 and shall normally be the Standby timer (i.e., immediately available if the Operate timer fails). Any failure of either Loran-C timer shall be promptly corrected.

(11) Phase Recorders. "Operate" standard shall always be connected to the "A" input. The recorder is read exactly as the front panel is marked, however, these readings are reversed from the conventions of Table 2-2.

(12) Miscellaneous.

(a) Status Alarm Unit (SAU). ECD alarm limits shall be set to $\pm$0.5 microseconds about the value of assigned EPA ECD for the Loran-C rate normally monitored by the SAU.
(b) Time Interval Counter (TIC). The TIC shall display the TINO unless needed to temporarily display another timing parameter.
(c) Electrical Pulse Analyzer (EPA). The digital panel meter in the EPA shall be in the pulse-peak/ECD mode unless temporarily used for other measurements.

e. Watched/Unwatched/Unattended Operations. Three categories exist in this area depending on whether the station is capable of being controlled using the ROS. Unattended operations will be covered in a later section. The transmitting station operation is unwatched when the control station enters commands via the Remote Control Interface (RCI). Conditions which must be met to assume an unwatched mode are:

(1) SAU Capability. The unwatched mode is permitted ONLY IF the SAU is in a "green" condition. A transmitting station shall NEVER be unwatched without a properly operating SAU.

Pulse occurs to the left in time of the reference pulse.	Pulse occurs to the right in time of the reference pulse.
The time difference is negative. e.g. Negative ECD is caused by the envelope moving to the left of the carrier.	The time difference is positive. e.g. Positive ECD is caused by the envelope moving to the right of the carrier.
This is a time ADVANCE. If a pulse generated from a frequency standard moves to the left in time, that standard is higher in frequency than the reference standard.	This is a time RETARD. If a pulse generated from a frequency standard moves to the right in time, that standard is lower in frequency than the reference standard.
An increase in the frequency of a standard will result in a negative or time advance movement of a pulse generated from the standard. A positive C-field correction results in an increase in frequency.	An decrease in the frequency of a standard will result in a positive or time retard movement of a pulse generated from the standard. A negative C-field correction results in an decrease in frequency.
A positive LPA or daily phase change record will be generated by a secondary station standard which is higher in frequency than the reference (Master) standard. The Loran-C pulse generated from the standard moves to the left in time which requires positive LPAs to correct.	A negative LPA or daily phase change record will be generated by a secondary station standard which is lower in frequency than the reference (Master) standard. The Loran-C pulse generated from the standard moves to the right in time which requires negative LPAs to correct.
An ADVANCE correction (LOIS) program negative value) applied to a phase microstepper will increase the apparent frequency of the standard.	A RETARD correction (LOIS program positive value) applied to a phase microstepper will decrease the apparent frequency of the standard.

TABLE 2-2. Time Measurement Conventions

2.C.3.e. (2) RCI Capability. The RCI must be functioning properly and adequate teleprinter communications must be available. The COCO may waive this requirement only if adequate emergency communications exist (e.g., 9th pulse blink, HF SELCALL, etc.) and control station personnel are trained to handle extended periods without RCI capability.

(3) Baseline Control. The transmitting station is NOT responsible for control of any baseline.

(4) Watchstander. The Watchstander shall be within range of and able to respond to the audible alarms. If the alarms are loud enough to wake the watchstander, then the watchstander may sleep.

(5) Duty Technician. The Duty Technician shall be on-call (able to contact station within 5 minutes of call). Response time (recall to station) shall be determined on a station-by-station basis by the CM. Personnel returning to the LORSTA shall comply with all posted traffic laws and speed limits and return at safe speeds commensurate with weather and road conditions. Personnel shall not attempt to return to the LORSTA if conditions have deteriorated to the point that routine travel would be considered life threatening.

(6) Notification of Watched Operations. Most Loran-C transmitting stations have insufficient billets to cover a long-term period of "watched" operations. The COCOs will immediately inform the CM if "watched" operations for more than 72 hours appear necessary.

f. Status Board. All transmitting stations shall maintain a system status board in the operations room. The status board will be at least 24"(60 cm) by 36"(90 cm) and posted in a prominent location easily read from the watchstanders' normal work-station. An example for a status board for a TTX station is provided in Figure 2-5. Status boards at host nation stations may be in the national language. The status board shall contain:

(1) All operating parameters.

(2) "Remarks" section. This section should contain all information of interest to the watchstander, e.g., pending events (time steps, CASREP information, scheduled AUTM, etc.)

g. Check-In. Each transmitting station shall communicate with the control station at least once every 24 hours. Contact will normally be during working hours and in conjunction with the system sample. COCO directives will specify both the check-in time and what checks, readings, etc., must be done. Additional check-in times may be required if operational necessity dictates. These additional check-ins should not conflict with normal work and sleep routines, or (where applicable) incur overtime charges. At a minimum, during the check-in, the watchstander will:

2.C.3.g. (1) If needed, match the phase of the standby and tertiary standards to that of the operate.

(2) Reset the watchdog timer.

(3) Take the necessary data readings for the daily operations report to COCO (if check-in occurs at system sample.)

(4) Check and log the number of RCI commands, the numbers present on the blink and off-air counters, then re-zero the counters.

(5) Test all communications links and Loran Timing and Control Equipment alarms.

(6) Conduct a daily system check. Since equipment suites differ from station to station, COCO will specify the details.

4. Loran Monitor Site Operations.

a. Introduction. The primary source of information for control of the Loran-C system comes from the Primary Chain Monitor Sets (PCMS). The PCMS is normally at an unstaffed site, however, it is sometimes co-located with the control station. At remote unstaffed sites, access is limited to authorized personnel.

b. Maintenance.

(1) PCMS Support. The PCMS is maintained by a nearby support facility, in the case of remote sites, and by the control station for co-located PCMS sites. Maintenance shall be in accordance with current technical manuals, CM, and SM directives.

(2) Remote Failure Determination. For remotely located monitor sites, the control station shall use the GCF-W-877-Loopback to determine if a failure is due to PCMS equipment or a communication outage.

(3) Recall and Response Time. The CM shall establish recall procedures and response times for PCMS equipment failure. Technician response time shall not exceed 24 hours.

$$Vp = \frac{1}{10}\sqrt{\frac{2P}{Rr}}$$

where Vp - Assigned Vp in Volts
P - Radiated power in Watts
Rr - Antenna radiation resistance in Ohms

Status Board Example

2.C.4.c. Notch Filters.

(1) F-1543/FSN-2(V) Notch filters. Modifications to notch filters shall only be made with approval of the cognizant CM and in accordance with the current technical manual, CM and SM directives.

(2) CDFO-5000A Receiver Internal Notch Filters. The CDFO-5000A shall be operated with the internal notch filter switch in the OUT position (i.e., internal notch filters not in the signal path) except when specifically authorized by the cognizant CM. These notch filters shall only be operated for trouble shooting and on a temporary basis when an unnotched interference source is located until permanent external notches can be installed.

d. Environmental Changes. Any changes in site topology or the site environmental system (heat, air conditioning, etc.) that affects the loran-C signal shall be reported to the CM. When a change is observed which might effect the site or antenna ground system, the CM shall ensure that new ground measurements are taken as soon as practical.

5. Remote Operations.

a. ROS Personnel. The SSX LORSTAs will normally operates with a crew of four enlisted personnel with the assigned Chief Electronics Technician designated as Supervisor or Officer-in-Charge (referred to hereafter as Supervisor). The TTX stations will typically operate with five or six crew members. The routine Loran-C watchstanding functions will be carried out by the control station watchstander. Loran-C watchstanding functions will not normally be assigned to LORSTA personnel. However it may be necessary to have a live watch at the transmitting station. The control station watchstander will monitor the signal parameters, environmental conditions, and buiding security via the ROS. Each person attached to the ROS station shall be required to stand recall duty and have a recall number listed with the control station. When on call, they shall be available at the listed telephone number (or by a pager). Conditons requiring differing readiness (response time and number of people on call) are covered in CM or COCO Instructions.

(1) Officer-In-Charge (OIC). The attached Chief Electronics technician will be assigned the duties of the OIC. In sections of this Manual. Maintenance of the building, emergency generators, electrical plant, transmitting antenna, and associated ground system will be performed according to existing Coast Guard Directives, and arranged (or contracted for) by a support command. The OIC must keep the support facility aware of items needing attention. The station crew is responsible for the maintenance of

2.C.5.a.(1) (Cont'd) electronic equipment. The OIC shall schedule equipment maintenance and watchstander training. The training program shall be coordinated with the COGO.

(2) Electronics Technicians. The technicians' responsibilities are the same as they would be if the station were not remotely operated. All personnel assigned to the LORSTA will be qualified to assume a Loran-C watch according to the requirements herein, and those published by the RM, CM, and COCO. The duty watchstander shall be capable of reaching the station within the time specified after receiving notification by the control watchstander. The response time will be specified by the Program Manager for different LORSTAs, depending on reasonable response times from available family housing in the area. Typical response time should be less than 30 minutes. Response time will be further addressed by the COCOs in their supplemental instructions. Personnel returning to the LORSTA shall comply with all posted traffic laws and speed limits and return at safe speeds commensurate with weather and road conditions. Personnel shall not attempt to return to the LORSTA if conditions have deteriorated to the point that routine travel would be considered life threatening.

(3) Watchstanders. LORSTAs will operate in the unattended mode whenever possible. In this mode of operation, the routine Loran-C watchstanding functions will be the responsibility of the control station watchstander. There is no requirement for an on-station watch in this mode. If the "watched" mode of operation becomes necessary, an on-station watch is required to assume the responsibility for the watchstanding fuctions.

(4) Control Watchstander. The control watchstander will use the ROS equipment to monitor the remote station's alarms; perform "routine" watchstander duties for the remote LORSTA including insertion of adjustment(s) to maintain the transmitted signal in tolerance; and switch equipments when a casualty occurs. The control watchstander will also notify the transmitting station duty technician of station alarms that require their recall to the LORSTA.

b. Control. SThe specified control methods in use for the chain and their order of priority apply to operation in the ROS mode. The policy for changes in control will be amplified by COCO instructions or supplemental control procedures. A change in control method does not imply that remote operations should be suspended, or that the duty technician should be called.

c. Determination of Operation Mode. The mode of operation is detemined by the location of the watchstanding responsibility for the signal (i.e., Control Station or Transmitting Station). Control is determined by the location of the receiver being used for monitoring baseline parameters (i.e., Alpha, Bravo, Charlie, 2.C.5.c (cont'd) or Delta). To ensure that personnel from the two units do not attempt simultaneous equipment shifts or problem correction, the watch responsibility must be strictly followed. The criteria for watch responsibilty shall not be based solely on the presence of personnel at the LORSTA. For example, the mode of operation is either the control station when they are controlling the baseline using the information on the ROS or the Alpha 1, Alpha 2, Bravo, Charlie, or Delta depending where the receivers that are used to monitor the baseline are located. It is possible for the control station to control a baseline in Bravo control. If the master station is unattended and the Bravo parameters are being monitored on the ROS by the control station, this would be called Bravo (control station).

d. Daily Requirements. The COCO will set the daily requirements for the LORSTA watchstander to report to the control station. The COCO shall require station logs to be kept by both the control station and LORSTA. The COCO shall issue directons on how the message traffic shall be passed for the LORSTA. A procedure shall be established by COCO when changing the LORSTA duty technician. An on-site krelief is normally required and shall be conducted during hours convenient to all concerned. There is no requirement that operations be shifted dudring a change of watch at the LORSTA or control station. Procedures must also be established by COCO for the control station to assume the responsibility for specific LORSTA operation using the ROS.

e. Operational Parameters. The RM shall publish the assigned values for the ROS alarms; the tolerances and "no-way" parameter upper and lower bounds for various parameters. The order and types of ROS alarm contact closures may be designated to permit uniformity at the control station for the various LORSTAs controlled.

f. System Software. Only approved software designated by the Support Manager will be used for ROS operations. LORSTA and control station personnel shall make no modification to software or parameters unless specifically directed. The version number and serial number of each disk shall be on record with the RM. be retained onboard.

6. Precise Time and Time Interval (PTTI).

a. Introduction. All Loran-C transmissions are synchronized to the Universal Time Coordinated (UTC) scale. This scale is maintained by the U.S. Naval Observatory (USNO) and referenced to the master clock. All transmitting stations are equipped with cesium beam frequency standards and all chains are controlled to within 2.5 microseconds of UTC in time and to within 5 parts in ten to the thirteenth in frequency. The

2.C.6.a. (Cont'd) Loran-C chains are monitored by USNO and data are published at periodic intervals via Time Service Annoucements. since transmissions are synchoronized to USNO, time users have traceability to UTC via the Loran-C system. Time recovery can be sub-microsecond using the Loran-C system with proper equipment at a know location.

b. Measurement Methods. The Loran-C signals are monitored by various means to determine their time relationship to UTC. These methods include precise time reference stations, satellite and TV time transfer, portable clock comparisons, cross-chain timing measurements and direct measurements at USNO.

c. Synchronization Responsibility. the responsibillity to synchronize the Loran-C sytem to UTC rests with the U.S. Coast Guard. Requirements and criteria are contained in a DOD and DOT memorandum of understanding. Specific responsibilities are:

(1) Program Manager. Maintain coordination with USNO for the purpose of updating, monitoring, and modifying requirements or procedures as necessary to ensure Loran-C transmissions are maintained within the specified UTC criteria.

(2) Regional Manager. Coordinate inter-chain and intra-chain synchoronization for all Loran-C chains in each region.

(3) Chain Manager. Synchronization of each chain to UTC, overall coordination of intra-chain synchronization and frequency control of the master operate standard. Frequency control of the master operate standard maybe delegated to COCO for oscillators under control of Chain Manager.

(4) Coordinator of Chain Operations. Intra-chain coordination and control of all frequency standards except the master operate standard.

d. Synchronization: General. Sychronization of Loran-C transmissions to UTC is defined by an assumed coincidence of the start of the master first pulse with a specified Universal Time Second (UTS). The first Time of Coincidence (TOC) was arbitraily defined as 00:00:01, 1 January 1958, for all master stations. Knowledge of the Loran-C rate and time scale adjustments is all that is needed to compute all future TOCs. This informatilon is published yearly by USNO.

(1) Inter-Chain Synchronization. Inter-chain synchronization is the measurement and adjustment of the time of transmission of the master's first pulse to be within the published limits with the UTS at TOC. This time-difference does not remain constant due to frequency offset between the master's operate cesium beam standard and UTC. Measurement is accomplished by cross-chain timing

2.C.6.d.(1) (Cont'd) measurements or time of arrival (TOA) measurements by time monitor stations. Inter-chain synchronization criteria are.

(a) Frequency: UTC(USNO)-Chain < 5x10 (-13)

(b) Time: UTC(USNO)-Chain < 2.5 @sec

(2) Intra-Chain Synchronization. Intra-chain synchronization is the process of maintaining secondary station transmissions at CSTD at the Alpha monitor and adjusting the frequency offset of the standards at all stations in a chain. Operate standards (with phase microstepper) compared to the Master operate standard are to be within 2 parts in 10 to the 13th and secondary and tertiary standards (with c-field adjustments) within 5 parts in 10 to the 13th.

e. Procedures.

(1) Inter-Chain Synchronization Plot. Requirements for maintaining inter-chain synchronization consists of plotting the daily USNO time-difference values on K&E 47-2890 graph paper for each chain. At some dual-rated stations, cross-chain timing measurements are taken daily. The cross-chain monitor data are forwarded to USNO and utilized to verify accuracy of the USNO monitors for both the USNO and the CM.

(2) Intra-Chain Synchronization Plot. Intra-chain data requirements consist of maintaining LPA totals for the chain secondaries and linear phase recorder plots of the standby and tertiary oscillators on each station. Intra-chain synchronization is maintained by inserting small time steps in the form of LPAs to keep the long-term TD near CSTD at the Alpha monitor. Frequency adjustments are inserted via the C-Field dial to keep the frequency offset to within five parts in 10 to the 13th among standards on a station. Each station inserts small time steps into the standby and tertiary standards via phase resolvers. Phase microstepper adjustments are made to the operate standard to ensure frequency coherence with the master station to within two parts in 10 to the 13th for phase. The following data must be compiled:

(a) LPAs. Daily sum of LPAs inserted at each secondary. The LPAs are inserted to correct for frequency differences between the master and secondary stations' operate frequency standards. Timing adjustments inserted to correct for equipment changes are known as Maintenance Phase Adjusts (MPAs). It is important that timing adjustments entered to correct for equipment changes be logged as MPAs. The LPA data are used by COCO to calculate frequency standard offset, 2.C.6.e.(2)(a) (Cont'd) and including MPAs with these data will distort the calculation.

(b) Linear Phase Recorder Change. The net frequency offset of the standby and tertiary oscillators are compared to the operate oscillator. The reading for a particular day is taken adding (for a positive slope) or substracting (for a negative slope) 200 nsec for each crossover the chart recorder made during the previous 24 hours. If the TCE resolver dials are used rather than the linear phase recorders for this data, the dial reading is subtracted from the previous day's reading and the difference multiplied by two to convert the readings to a time-difference in nanoseconds.

(3) Analysis.

(a) COCO Weekly. The COCO performs a weekly analysis of all of the oscillator frequency offsets. The COCO also monitors the performance of the oscillators for any abnormal indications and alerts the chain manager of any abnormalities. There are several types of oscillators:

1. oscillators with serial numbers of 560 and below.
2. oscillators with serial numbers of 561 to 1583.
3. oscillators with serial numbers greater than 1584.
4. either type oscillator with a phase microstepper.

(b) Oscillator Offset. To ensure COCO uses the best estimate of the frequency offset of the oscillator, and that the correction falls within the resolution of the C-field dial or microstepper, the following conditions should be met. All of these conditions can be overridden by the COCO in the event that oscillator with large offset or an oscillator casualty has occurred that requires immediate correction.

1. At least 30 days' worth of data since the last correction.

2. A standard deviation of the estimate of the offset which is less than 1/3 of the estimatd offset.

3. For a low serial number (560 and below) osicillator, the offset must be greater than 4.32 X 10 (-13).

2.C.6.e.(3)(b)

4. For oscillators with serial numbers 561 through 1583, an offset which is greater than 2.16 X 10 (-14).

5. For a phase microstepper installation, an offset which is greater than 2 X 10 (-14).

(4) Procedure. The COCO directs an oscillator adjustment by message to the station. The station reports the correction on the next daily operations report following its completion. Further, the COCO reports the corrections and current frequency offset control setting to the CM on the next weekly report, and shall report the statistical summary of oscillator performance to the CM monthly via the report of Loran-C Chain Operations. Instructions for these reports are contained in section 2.E.3.

(a) LPA and Daily Phase Change. Table 2-2 gives conventions for the time interval measurements, frequency standard offset and special Loran-C applications.

1. If the daily LPA record is positive, then the secondary station operate standard freqquency is higher than the master operate standard and a retard phase microstepper correction (shown as positive by the LOIS program) is required to reduce the secondary operate standard frequency.

2. If the daily phase change record is positive, then the standby or tertiary standard frequency is high with respect to the operate standard at the station. A negative C-field correction is required to the standby or tertiary standard.

3. Conversely, if the LPA record or the daily phase change record is negative, then the associated frequency standard is lower in frequency than the reference. A positive C-field correction or an advance phase microstepper correction is required.

(b) Frequency Adjustment. When the frequency offset of the master operate standard exceeds 5 X 10 (-13) (approximately 50 nsec per day), a phase microstepper adjustment should be made.

(c) Timing Adjustment (Time Step). A timing adjustment is inserted similarly to an LPA, except that all stations in the chain insert the adjustment simultaneously. If the standard offset increases suddenly, due to a USNO computation error or new installation, a time step shall be used to ensure the chain remains within tolerance. Specific time step procedures will be published by the CM.

2.C.6.e.(5) User Notification. When a time step, or frequency change to the master operate oscillator is required, the COCO shall issue an AIG message with the information at least 14 days prior to the action date. This lead time will allow the USNO to advise users and request a postponement, if necessary. routine adjustments shall be scheduled on Fridays to correspond with the USNO Time Service Announcements. In emergency situations where 14 days would allow the frequency offset to exceeed 2.5 microseconds from UTC, a shorter lead time is acceptable after coordinating with USNO.

(6) Cross Chain Timing Measurement and Reporting.

(a) Procedure. In order to determine the precise timing with respect to UTC (USNO), cross chain timing readings are taken, at some dual-rated stations, and reported to USNO, CM, and RM. Daily measurements are taken between the standard sampling points of the antenna current waveforms of the two Loran-C signals. The actual measurement is the timing difference between the high and low rate PCI minus LEN (low rate) plus LEN (high rate) as shown by the following:

1. Local Cycle Number (LCN) measured on the TCE Time Interval Counter (TIC):

start: Local PCI, positive trigger.

stop: EPA Envelope trigger (same rate), positive slope.

2. Cross Chain Time-difference (CCTD), measured on the TCE TIC:

start: Local PCI, low rate, positive trigger.

stop: Local PCI, high rate, positive trigger.

Use the last three digits (XX.X microseconds) when the TIC reading is as small as possible.

3. Compute.

Result = CCTD - LCN low rate + LCN high rate

4. report the resultant number as required by RM.

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2.D. **Casualty Operations.**

1. General.

   a. Introduction. The following sectons porvide instructions for Loran-C Casualty operations. The instructions are divided into Control Station Procedures, Transmitting Station Procedures, and Casualty Reports. In the following sections, the term Control Station refers to that portion of a LORSTA or LORMONSTA that has the primary responsibility for baseline control. The type of control is designated Alpha() control (i.e., Alpha-1, Alpha-2, etc.) When non-Alpha baseline control is passed to a LORSTA, that LORSTA becomes the alternate controlling station or station in temporary control of the baseline.

   b. Control Methods. All Loran-C transmitting stations free-run using installed CesiumBeam Standards. The master station is equipped with Loran-C receivers to provide a single pseudo time-difference for each baseline in the chain. the secondary station has one Loran-C receiver (two receivers for dual rated stations) to provide a pseudo time-difference for the baseline. The control station os the only station equipped for proper TD control; that is, true time-difference receivers with redundancy for error checking and calibration capabilities. The control station is expected to maintain continuous real-time control over all baselines assigned (Alpha control). The transmitting stations are not staffed or equipped for extended control. Recognizing that equipment failures or other conditions such as local interference will render the control station incapable of proper control at times, formal assignments and limited capaility for alternate control methods are porvided. These alterante control methods are defined as follows:

      (1) Bravo Control Baseline control using information from a Loran-C monitor receiver at the master station. If Bravo control is being performed by a watchstander at the master station it is referred to as Bravo-Transmitting Station control. If ROS is installed at the master station and Bravo control is being performed by a watchstander at the Remote Site Operating Set (RSOS) station (normally the Control Station), then control is referred to as Bravo-Control Station control.

      (2) Charlie Control Baseline control using information from a Loran-C monitor receiver at a secondary station not in the baseline. When more than one secondary station can be used, the designation is Charlie-1, Charlie-2, etc. If Charlie control function is being performed by a watchstander at the non-baseline secondary station, it is referred to as Charlie-Transmitting Station control. If ROS is installed at the secondary station and control is being performed by a watchstander at the RSOS station (normally the control station), then control is referred to as Charlie-Control Station control.

2.D.1.b. (3) Delta control Baseline control using information from a Loran-C monitor receiver at the secondary station of the baseline. If Delta control function is being performed by a watchstander at the secondary station, the control is referred to as Delta-Transmitting Station control. If ROS is installed at the secondary station and control is being performed by a watchstander at the RSOS station (normally the control station), then control is referred to as Delta-Control Station control.

(4) Local and Remote Control of the Timer. Alpha, Bravo, Charlie and Delta may be further specified as being local or remote, depending on the location from which control commands are entered into the Loran-C Timer.

(a) Local Timer Operation. In local Timer operation, the watchstander enters commands to the Timer front panel controls, or into its RCI from the station teletype, or if ROS is installed, from the Local Site Operating Set (LSOS) computer.

(b) remote Timer Operation. In remote Timer operation, the watchstnder enter into the Timer's RCI from the control station teletype, or if ROS is installed, from the RSOS computer.

c. Priority of Control. In general, Bravo, Charlie, and Delta control methods foffer the same quality of control since the equipment is the same. The RM shall establish the priority of the control methods used. the priority which requires the fewest watchstanders at the transmitting stations for control is preferred, but other factors such as interference or different transmiting prowers may make a different priority more preferable.

d. Control Status.

(1) Changes of Control. The control station shall retain Alpha control of the baseline unless TD information becomes unreliable due to receiver disagreement, equipment failure, or monitor interference (man-made or natural). Control of the baseline shall be passed to the next control method in order of priority (This may be by the same station utilizing information from a different remote station if ROS is installed). Changes of control between modes of Alpha can be routinely made and logged only by the control station watchstander. The CM shall be notified when the baseline is in non-Alpha control continuosly for more than 72 hours.

(2) Intitial Problem Detection. regardless of baseline control status, if any station in the chain detects abnormal Loran-C equipment or receiver indications, the control station and all stations involved shall be contacted to determine the problem. The station watchstander shall be contacted by any type of communications available including: teletype or telex, "watch call" via the RCI or ROS, master 9th pulse blink, HF Sel Call,

2.d.1.d.(2) (Cont'd) commercial telephone, and ROS "plain talk". The plain talk feature of ROS should be used judiciously because when plain talk is used the ROS system is not collecting data. In such conditions, if the discrepancy cannot be resolved and the baseline is possibly out of tolerance, blink shall be ordered, control passed to the station having the most reliable information, and the COCO notified immediately to resolve the problem.

e. Passing of Control. Baseline control shall be passed by one of the following methods. If experience and local conditions so indicate, the RM, CM, or COCO may specify that one method always be used. Regardless of how control is passed, the directions in the follwing subparagraphs shall be followed.

(1) Teletype/Telex, Landline, ROS Two Pulse Communications. The station passing control will identify itself and provide the station assuming control, the past hour's deviation, and the reason for passing control, concluding with the time and watchstander's initials.

(2) Voice Radio or Telephone. The station passing control will call the station assuming control, direct such assumption giving the deviation for the past hour and the reason for passing control. The station assuming control will acknowledge with an affirmative statement of assumption, such as "Zulu assume Delta control minute 45". A simple "Roger" shall not be used to indicate assumption of control.

(3) Official Message. Use an immediate precedence message, listing the baseline involved, type of control, past hour's TD deviation, and reason for passing control.

f. Automatic Passing of Control. Under certain casualty and loss-of-all communications situations, control must automatically change. The control method to be employed will be explained in RM, CM, or COCO Instructions.

g. Control During Loss of RCl Communications. Emergency communications are critical for operating modern unwatched and unattended Loran-C stations. The COCO shall periodically test all emergency communications channels. These tests will help the COCO ensures that an adequate emergency channel exists at all times. The CM shall be notified of any inadequiate emergency communicatins capability.

(1) Non-ROS Stations. The loss normal RCI communications such as the teletype or telex is not sufficient reason to pass control. Each station shall have at least one form of emergency communication which can be used to direct the watchstander to insert LPAs or correct equipment problems necessary to keep the baseline parameters within tolerance. The control station watchstnder accepts a degraded ability to effect precise control of the baseline, but still retains control because corrections can be inserted via emergency communications. Such

2.D.1.g(1) (Cont'd) communication losses shall be entered in the control station log. The control station watchstander must be especially alert to use the emergency call well before signal parameters exceed tolerances. (Note: this method of control is Alpha-local). The control station watchstander may direct another rate's master LORSTA to blink a secondary under its control for emergency call purposes.

(2) ROS Stations. Under conditions of normal operation at a control station with ROS installed, the loss of normal RCI communication such as teletype or telex should be handled by utilizing the ROS LPA capability. (Note that this method of control is Alpha-remote).

h. Total Loss of Communication. Total loss of communication can always occur. Unwatched or unattended operations will almost never be detected unitil a casualty occurs, because there are no communication checks other than the routine operator check-in once per day. Whenever total loss of communication is determined at non-ROS stations, the secondary station shall immediately assume Delta control. With no prior information as to TD deviation as observed at the Control Station, a secondary station assuming Delta control under total communicaton loss conditions shall maintain the local timing reference (TINO and SYNC). At ROS stations the Control Station shall take whatever action directed in the RM, CM, or COCO instructions. Total loss of communication is covered more completely uner casualty procedures below.

Lapses of control are a matter of primary concern to COCO and immediate steps shall be taken to ascertain their cause and initiate corrective action.

2. Abnormal Conditions.

a. Time Difference. Abnormal conditions in baseline TD control are caused by an equipment malfunction at a transmitting station, by unreliable data from the monitor or watchstander error. Unreliable data at the control station may be caused by unknown propagation conditions, interference at the monitor site, or receiver failure. In the event of any of these conditons at the control station, the control mode shall be changed to either Bravo, Charlie or Delta (control station or LORSTA as appropriate) in accordance with applicable COCO instructions.

b. Correlated CSTD and Strip Chart. When the control station determines that control must be passed, it is vital that a correlated number be calculated at the station taking control so that CSTD is maintained as closely as possible. The correlated number for the station taking control is determined by subtracting the past four valid 15-minute average TD deviations (available from CALOC) at the control station from the station taking control's average TINO. When control is for each baseline to the station will pass the average TD deviations station will average the past hour's TINO from its strip chart

2.D.2.b. (Cont'd) 9recorder and subtract the past hour's control station TD deviation. This is the correlated number for the station. The tolerance for that baseline is then added and subtracted to the correlated number and these tolerance points marked on the strip chart. The Bravo, Charlie, or Delta control station will then proceed to determine 15-minute averages and mark these on the chart as per the instructions in this section. The Bravo, Charlie, or Delta control station will not plot information on the 15-minute average form nor be concerned with bias. They shall not enter an LPA unless the average (TINO) deviation from the correlated TD exceeds one-half of tolerance for a one-hour period. This is an example of this calculation:

Delta station TINO average	430
Alpha Monitor Receiver Deviation (-25) Subtracted algebraically	-(-25)
Delta correlated CSTD	455
Tolerance	100
Strip chart marks	<u>555</u>
	355

c. <u>Bravo, Charlie and Delta Control</u>. These controls conditions are clearly intended to be infrequent modes of operation and, in general, no LPA action under these control modes is preferred unless required by extended control station difficulties.

d. <u>ECD</u>. Abnormal ECD conditions may occur after equipment failures at the transmitting station. If an out of tolerance ECD is observed (CDFO-5000A receiver) by the control station following an equipment change at the transmitting station, then blink should be initiated and control passed to the transmitting station for resolution of the problem. However, if no equipment changes have occurred at the transmitting station, the situation is less clear and the RM's Supplemental Instructions should be consulted. Remember, "If in doubt, BLINK."

3. <u>Casualty and Casualty Procedures</u>.

a. <u>General Procedures</u>. The information in this section is applicable to control stations, transmitting stations and monitor sites. A "casualty" is defined as any failure to provide the user with a properly timed and usable signal. Prime concerns following a casualty are to regain time synchronizaiton and restore proper pulse shape and power. Usually these are not all lost simultaneously and the SAU (LSOS alarms at ROS equipped stations) at the transmitting station can assist the watchstander in quickly identifying the problem. Usually, the best recovery information resides with the transmitting station's timing and control equipment. Therefore, the responsibility for initial casualty recovery is placed on the transmitting station (or control station RSOS for stations with ROS installed). The impact of

2.D.3.a. (Cont'd) this philosophy will be to reduce cumulative blink and OOT time, recognizing that there is some increased risk of OOT without blink. Typically, when a casualty occurs, the transmitting station watchstander responds to the alarm, assumes control, and regains the transmitting station parameters.

b. Equipment Casualties. COCO shall be advised by Priority message, Information to the CM and Host Nation Agency or appropriate district office as applicable, when Loran-C equipment has failed and cannot be repaired within 4 hours. Equipment casualties include all mission-essential operate, standby, ancillary, and communications equipment. When an equipment outage is corrected, a routine message shall be sent to the same addresses that received the original casualty report. Corrective maintenance shall continue until the equipment is restored to full operational capability or it has been determined that repairs are beyond the capabilities of station personnel.

c. Secondary Station Blink. User notification, via secondary station blink, is initiated under these circumstances:

(1) Output power is less than one-half of that specified.

(2) TD out of tolerance.
(3) ECD out of tolerance.

(4) Improper phase code

(5) Improper GRI.

d. Casualty Procedures.

(1) Baseline Abnormality. When an abnormality occurs in a Loran-C baseline, it will first be detected either at the transmitting station Status Alarm Unit (SAU) or RSOS (where ROS is installed), or at the control station (receiver alarms). In either case, the watchstander at the affected transmitting station (RSOS station when ROS is installed) must assume control of the baseline and correct the problem, returning the baseline to proper tolerances.

(2) Non-ROS Control Station Watchstander Response. When an off-air or out-of-tolerance condition comes to the attention of a control station watchstander an a non-ROS station, the first setp is to verify receiver operation. The watchstander should then call the affected transmitting station, using the most rapid means. The transmitting station's automatic recovery mechanisms require from 30 seconds to one minute to return the signal on air and in tolerance; therefore, the control watchstander should wait no longer than 60 seconds from the start of the event. Immediately after the 60-second OOT period, the watchstander should start blink if it has not already been started by the transmitting station.

2.D.3.d.(3) ROS Control Station Watchstander Response. When an off-air or out-of-tolerance condition comes to the attention of the Control Station watchstander at an ROS station, the first step should be to verify the abnormality using the ROS by checking all remote indicators. If the watchstander sees the transmitting station out of tolerance, assume control (Bravo or Delta) via the ROS, and start blink. The Control Station watchstander will initiate transmitting station technician recall and attempt recovery via ROS (until transmitting station personnel arrive) by using ROS to switch equipment at the transmitting station (timer or transmitter), enter LPAs, or activate transmitter stop in accordance with COCO instructions. If ROS indicators report the transmitting station in tolerance and the Alpha receiver still indicates an out-of-tolerance, blink will be started and receiver operation verified.

(4) Non-ROS Transmitting Station Watchstander Response. The transmitting station watchstander is alerted to an abnormal condition by an SAU alarm or a watchcall. As soon as the watchstander arrives in the timer room, all local indicators must be checked. If an out-of-tolerance condition exists, the transmitting station watchstander assumes baseline control, starts blink if it has not already been started, and begins casualty recovery. However, if the transmitting station watchstander sees the system in tolerance, the control station watchstander will be contacted. The transmitting station watchstander shall then follow instructions from the control station watchstander. (Note: It is generally the responsibility of the control station watchstander to contact COCO and senior control station personnel, and the responsibility of the transmitting station watchstander to contact senior transmitting station personnel; specific guidance will be provided in station and COCO instrucitons.) The transmitting station watchstander's recovery actions will fall into one of the following categories:

(a) Immediate Casualty Recovery. The watchstander immediately recognizes the problem and can solve it by quick simple actions (e.g., timer switch). The watchstander takes the appropriate action to recover and contacts the Control Station watchstander afterwards.

(b) Delayed Casualty Recovery. The watchstander recognizes the problem, but realizes it will take a few minutes to solve (e.g., reset a circuit breaker in the transmitter building). The watchstander shall notify the Control Station watchstander first and then correct the problem. Always notify the Control Station watchstander if the problem cannot be solved without leaving the Timer room.

(c) Unrecognized Casualty. The watchstander does not recognize the problem and has no idea of how to proceed. The watchstander shall notify the Control Station watchstander and contact senior station personnel for assistance.

2.D.3.d.(5) Transmitting Stations With ROS Installed. At the RSOS (control station) the abnormal condition will manifest itself as a RSOS or CDFO-5000A ararm. The Control Station watchstander must immediately check the ROS alarms and parameters. If the Alpha monitors show the baseline out of tolerance, start blink and contact transmitting station personnel (institute a recall if during unstaffed operations). Casualty recovery procedures are described elsewhere.

(6) Resumption of Alpha Control. Once the problem has been resolved, blink has been stopped, and the control station has stable tracks on the baseline, the control station must re-assume control, even if the baseline is seen out of tolerance by the Alpha monitor. If the baseline is seen out of tolerance by the Alpha monitor, the Control Station watchstander shall re-start blink and notify COCO. In this case, the Control Station watchstander should attempt to correct the problem if tracks are steady and the error is within RCI or ROS range.

(7) Additional Abnormality Guidance. Further guidance on system abnormality procedures is presented in section 2.D.4 for Control Stations and section 2.D.5 for Transmitting Stations. Most situations can be anticipated and are covered by these sections; but the old adage still applies:

WHEN IN DOUBT, BLINK! (Make sure you notify senior personnel and COCO IMMEDIATELY)

4. Control Station Casualty Operations.

a. Initial Blink. A control station observing any of the conditions requiring blink shall direct the secondary station(s) on the affected baseline(s) via RCI (or ROS if available) to blink. If this fails, any other form of communications shall be used. If the secondary station is alerted by such an emergency alarm and cannot establish any other communication, the station shall follow the master in blink and automatically assume Delta control.

In addition to blink, the user and various levels of the operational chain of command shall be notified as described in section 2.E.3.

b. Actions During Transmitting Station Abnormalities.

(1) Once control has been passed, the control watchstander's role is to observe the progress and assist the transmitting station personnel as required (At non-ROS stations).

(2) Non-ROS Blink Notificaiton. During conditions of blink at non-ROS transmitting staitons, if no apparent progress is being made and the abnormality period is lengthy (about 5 to 10 minutes) then the Control Station watchstander shall notify senior personnel. Specific procedures will be contained in station and COCO instructions.

2.D.4.b(3) ROS Blink Notification. During conditions of blink at ROS transmitting stations, the control station watchstander shall notify transmitting station personnel if not already done (if necessary institute a recall), and notify control station senior personnel.

c. Dual-Rate Stations. In certain Loran-C chain configurations, common communications facilities may be in use between stations of more than one chain. During a casualty, a priority of communications must be specified to avoid possible confusion between two control stations where each controls one rate of a dual rate station (as well as the other transmitting stations on the communications circuit). In the case of a dual rate, master-secondary station casualty, the control station exercising control of the master signal has priority over the secondary signal. The RM will issue instructions concerning priority of communications and control for dual rate secondary statiosns and dual rate master-secondary stations.

d. Otehr Events. Phenomena such as polar cap absorption (PCA), sudden ionospheric disturbance (SID), weather fronts and magnetic storm systems often cause erratic ECD tracks, cycle selection errors in automatic receivers, and TD tracking errors. The exact parts of the service area that may be affected are not generally predictable. These random electromagnetic radiations may severely attenuate the Loran-C signal, thereby reducing the usable range in the coverage area.

(1) Sudden Ionospheric Disturbance (SID).

(a) General. A SID is generally a solar-induced phenomena (e.g., magnetic storms) occurring during daylight hours; the strongest symptoms are experienced during local apparent noon over the baseline. The symptoms are also stronger in regions closer to the equator. The mechanism that affects the Loran-C signals is a solar-induced depression of the ionosphere causing abnormally strong and early arriving skywaves.

(b) Symptons. The effects of a SID seen at the master and secondary stations will be phase shifts, and ECD and amplitude changes of the remote signal. Both remote signals will seem to advance or retard together (normal propagation errors are caused when one remote signal retards and the other advances). Any attempt to correct the signal irregularities by inserting LPAs would result in driving the baseline further out of tolerance. Regardless of the LPAs inserted, the ECD and amplitude will remain abnormal. A SID is gnerally of short duration (30 minutes or less) and occurs infrequently.

2.D.4.d.(1)(c) Effects of Monitor Location. The symptoms seen at the control station, and the degree to which they are seen, will depend upon the location of the monitor receivers. The effects will generally be minimal if the monitor receiver is located at the midpoint of the baseline, or equidistant from both the master and secondary transmitters. As the monitor is moved closer to either the master or secondary, it will see effects similar to those seen at the closer transmitting station.

Note: The CDFO-5000A monitor receiver will probably see changes in: the Time Of Arrival (TOA) of master and secondary stations, envelope number (ECD) of both signals, and gain number of both signals.

(d) Control Action during SIDs. Do not control a SID with LPAs. The shifts are too sudden. During these events, the Loran-C TD is unusable throughout the majority of the TD is seen out of tolerance at the controlling monitor and continue until normal conditions return.

(2) Polar Cap Absorption (PCA).

(a) General. The PCA events are also solar-induced phenomena. They occur only during daylight hours and generally last for several days. At night, normal conditions return. They are characterized by a medium to slow onset of symptoms (usually several hours), followed by reasonably stable but offset conditions, and a slow return to normal. Each night, as sunset occurs along the baseline, the offset gradually disappears, but it returns with sunrise the next day; this process repeats until the event ends. The symptoms observed thus far tend to indicate that PCAs are groundwave events, affecting the speed of propagation of the Loran-C groundwave. The symptoms appear strongest in regions close to the poles.

(b) Symptoms. The symptoms of PCAs seen at the master and secondary transmitting stations are basically limited to phase advances to the remote signal. That is, the master will see a decrease in TINO and the secondary will see an increase of the same approximate magnitude (in the absence of control). The onset of the TINO shifts may be masked by periods of erratic tracks, but a general trend should soon become evident (200-500 ns shift over 2-4 hours, in the absence of LPA activity). The LPA insertions by the control station watchstander will tend to compensate for the shift at the transmitting station (master or secondary) closer to the monitor, and simultaneously, will make the shift at the other greater. Generally, the event will stablize, leaving the affected baseline with stable tracks, offset from normal. Events are normally multi-day affairs; since the effects are only seen during the day, 2.D.4.d(2)(b) (Cont'd) the tracks will return to normal as sunset occurs along the baseline and the offset will return as sunrise occurs.

(c) Effects of Monitor Location. At the control station, the effects of the PCA will generally only be seen on the TD tracks, and again, only during the daytime. If the monitor is equidistant from both transmitters, it will see no offset, as both signals will advance the same amount. If the monitor receiver is closer to the master, it will see a negative shift in TD; if nearer the secondary, a positive shift. In either case, the shift will generally be smaller than seen at the transmitting station.

Note: The CDFO-5000A receiver will see increases in both the master and secondary sample numbers. The onset may be characterized by erratic activity, but the medium-term shift trend should soon become apparent. Except during periods of erratic activity, the tracks will remain controllable. Once the event has reached its stable period, the TD offse should remain fairly constant from day-to-day.

(d) Control Action During PCAs. While a SID is easily identified by its rapid shifts, a PCA is not. In many cases, the PCA will appear slowly and its effects will be removed from the monitor receiver's tracks by the normal control process. Care must then be takne to identify the onset of an event; generally, this will be detected several hours after the event starts. The COCO shall then be notified, and will coordinate the control actions. Specific control acitons for each baseline in the chain will be provided by COCO, generally in accordance with paragraph 2.D.4.d.(3).

(3) Control Action During Other Events.

(a) LPAs. All LPA insertions shall stop and secondaries possibly affected shall free run. The LPAs inserted after the event began (during sunset or sunrise transition in multiple-day events) shall be removed.

(b) Free-Run Time. Free-run time is the time required for the frequency offset of the master and secondary oscillators to cause synchronization changes that, when algebraically added to the latest TD deviaiton, exceeds two-thirds tolerance. Free-run time shall be calculated by COCO based on the best available information. When the length of free-run time exceeds this time, the baseline shall be blinked.

(c) Gain Deviations (GD). The control station shall ensure that Gain Deviations (GD) on the CDFO-5000A receivers are set to ensure that the strobes stay positioned over valid tracks points for the longest possible time.

2.D.4.d.(3)(d) User Advisories. The COCO shall issue a user advisory message. When the event has terminated, an advisory canceling the warning will be issued.

e. Control Station Casualty Procedures.

(1) Control Station Watchstander. Actions to be taken by the control station watchstander are detailed in the following sections. The major purpose of the control watchstander (non-ROS) in the event of an abnormality is to initiate secondary blink on the affected baseline and notify transmitting station personnel (e.g., watchcall). Normally, the first indication that an abnormality exists will manifest itself in the form of a CDFO-5000A alarm as shown in the following examples:

	Abnormality	Alarm
(a)	Off-air or low power	Gain error
(b)	TD out of tolerance	TD error (small error) Gain error (Large error -- time jump)
(c)	ECD out of tolerance	ECD error (may be Gain error)
(d)	Improper phase code	Phase code error

(2) PCMS (CDFO-5000A Monitor Receiver) Casualty Procedures. The Control Station watchstander must be aware that the CDFO-5000A receiver is not a primary casualty recovery equipment. Because of its distance form one or both of the transmitting stations the lengthy time necessary to detect the effect of recovery procedures limit its effectiveness as a casualty recovery device. In general, CDFO-5000A receiver settings should not be modified. However, if the abnormality has been lengthy and the CDFO-5000A receiver informaiton is good, the Control Station watchstander may attempt to assist with the correction of the problem. In these circumstances, CDFO-5000A operating parameters should be changed as the situation dictates. (Note: if it becomes necessary to perform a re-acquisition (ACQ), care should be taken to transfer control to another Alpha receiver or transmitting station, as required, to avoid a lapse of control on another baseline.)

Note: It is not considered a casualty when necessary to change Alpha monitors or method of control (Alpha to Bravo, Charlie, or Delta) due to equipment failure, high noise, maintenance, etc.

2.D.4.e. (3) Casualty Procedures using CALOC. Although CALOC should never be used for caualty recovery, it may be used for calculation of the last hour's TD deviation when it is necessary to pass control to another station. At the onset of an out-of-tolerance situation, the Control Station watchstander should log the baseline ABNORMAL on the CALOC, so that subsequent calculations on that baseline are inhibited. To resume normal CALOC processing, the watchstander must order a CONVERGE and then a RESUME.

(4) Control Station Casualty Flow Chart. Figure 2-6 is a generic guideline for the handlng of most casualty situations which can be anticipated. It is written for the control station watchstander. Because this flow chart cannot cover every possible eventuality, the COCO may modify or expand it to meet special circumstances or configurations. The term "control station" in the flow chart refers to the designated Alpha control station regardless of which station has actual baseline control at the time. If a situation not covered by the flow chart occurs, notify COCO and senior personnel immediately and rember: WHEN IN DOUBT, BLINK!!

f. Communications. Communications failures (control, administration, ROS, and PCMS data lines) shall be addressed on a station-by-station basis by the responsible CM. For dual rate stations with two CMs, the RM shall coordinate with the two CMs. For dual rate stations with two RMs, the RMs coordinate between themselves.

5. Transmitting Station Casualty Operations. This section does not discuss remote operations. For ROS procedures see section 2.D.6.

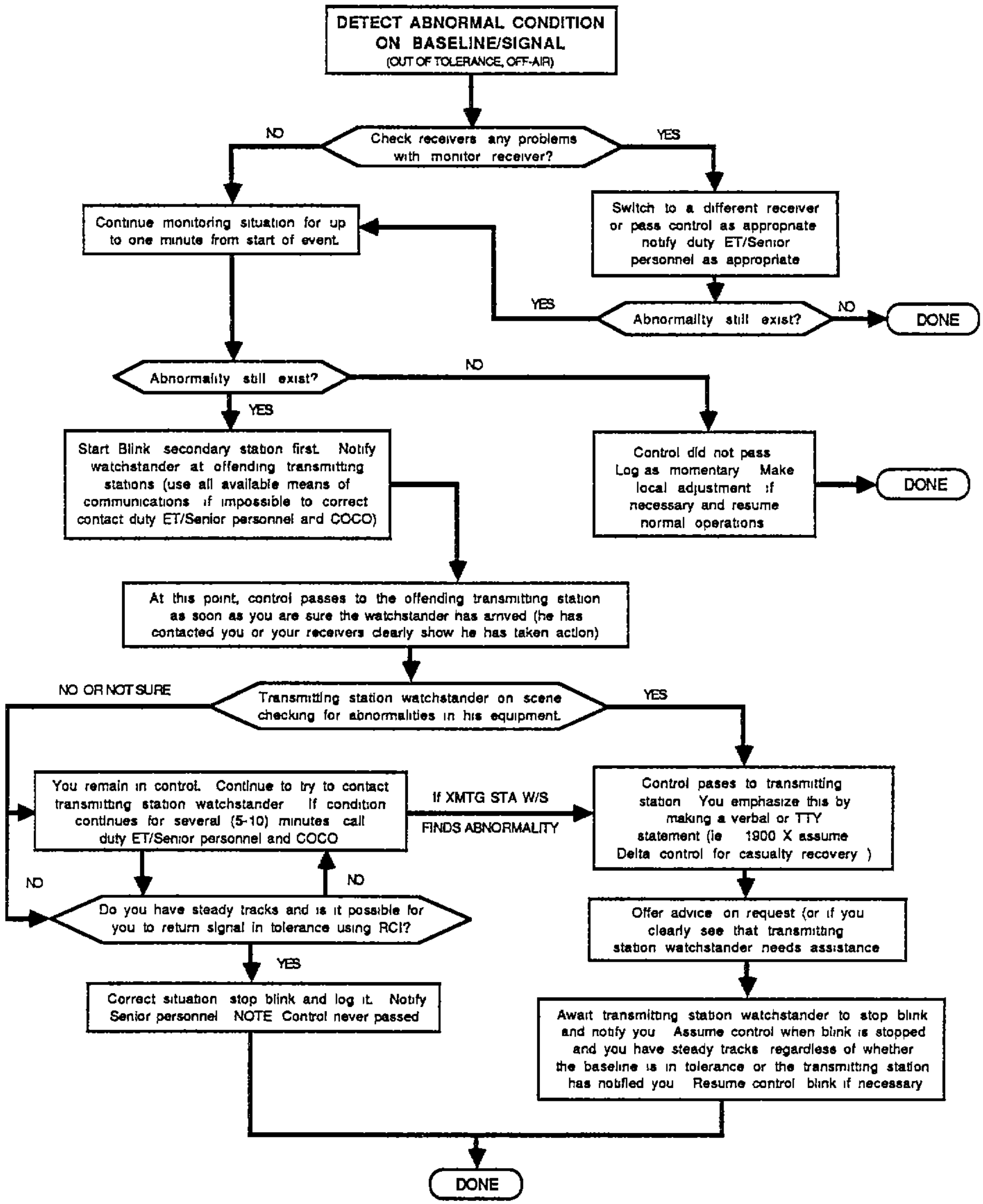
a. Blink. A transmitting station observing any of the conditions requiring blink shall assume control, initiate blink, and begin casualty recovery procedures as outlined below. When a secondary station is called via watchcall or master blink, the transmitting station watchstander should check local parameters before starting and securing blink (if called by master blink, answer blink, secure blink only after Master blink has been stopped) to avoid unnecessary secondary blink.

b. Casualty Recovery Procedures. The general procedure is:

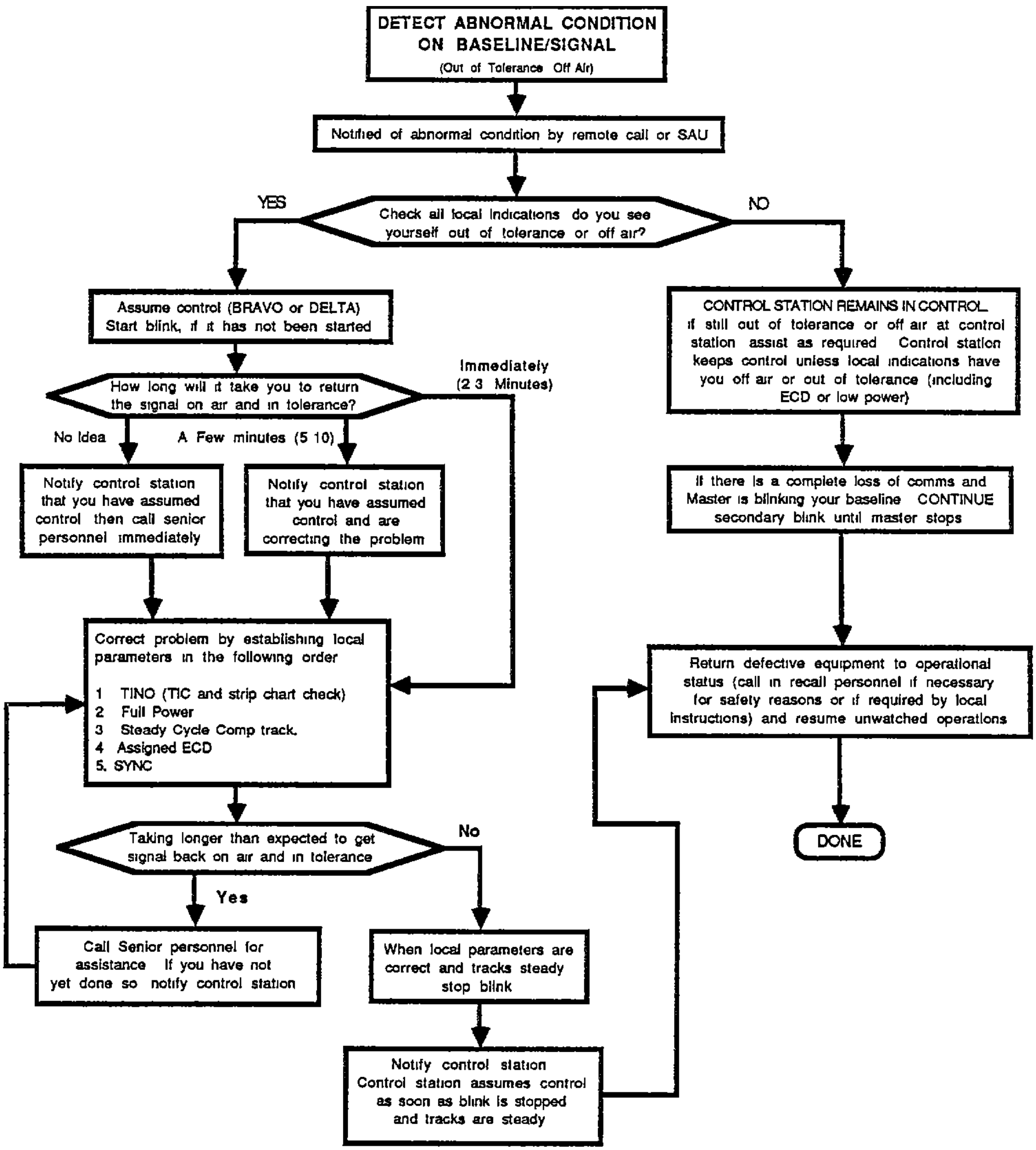
(1) Response. The transmitting statin watchstander responds tothe alarm.

(2) Parameter Control. The transmitting station watchstander regains the local control parameters, i.e., TINO, LEN, SYNC, Vp, Steady Cycle Compensation, ECD, that specify the correct operational condition of the station.

(3) Reporting. Report the casualty and recovery to the control station. For more specific guidance in recovery procedures see Figure 2-7. This flow chart cannot cover every possible eventuality and is presented as a generic example. The COCO may modify or expand the flow chart to meet special circumstances or



Control Station Casualty Flowchart.



Transmitting Station Casualty Flowchart.

2.D.5.b.(3) (Cont'd) configuration. Most situations are covered by the flow chart and discussion above, but the old adage still applies if an unusual situation occurs:

WHEN IN DOUBT, BLINK! (Then contact senior personnel)

c. Flow Chart Explanation. Although the flow chart is written for a transmitting station watchstander, it is generally applicable to the control watchstander at ROS-equipped stations. The term "control station" in the flow chart refers to the designated Alpha control station regardless of which station has actual baseline control at the time.

6. Remote Operating Systems (ROS).

a. Response to Abnormalities. In the event of an abnormality, the duty technician shall perform only such actions that do not require exposure to hazardous voltages or violate Coast Guard safety regulations. Safety procedures contained in the Electronics Manual (COMDTINST M10550.1 series) and Coast Guard Regulations (COMDTINST M5000.3 series) shall be strictly followed. Technicians shall not physically repair equipment without a second person present. When redundant equipment is placed in operation, the technician will recall a backup person so repairs can be made as soon as possible. If the technician determines the operate equipment will perform until the following morning, repairs may be delayed until the next day with STO and COCO's approval. In any event the technician shall advise the control station, COCO, and the station supervisor of action(s) taken. A Priority CASREP message is required.

b. Response to Auto Fire and Intruder Alarms. The fire and intruder alarms may have dialers with the telephone numbers of the appropriate authorities as well as the telephone number of the person on call. The authorities must not be burdened by false alarms; otherwise, they may not respond quickly next time. Therefore, it is imperative that these alarms be in proper working order. Any failure of the fire or intruder alarms will require an on-site security watch.

c. Recall of LORSTA Duty Technician. The duty technician must be called anytime an abnormality occurs which:

(1) Was caused by LORSTA equipment, or

(2) Affects the remote capabilities at the LORSTA or Control Station.

d. Use of the Transmitter Emergency Stop. Anytime an abnormality occurs that places the LORSTA signal out of the proper interval, and the Control Station watchstander has determined the transmitted signal cannot be returned to tolerance, the Control Station watchstander shall use the emergency stop function and shout down the LORSTA transmitter, in accordance with COCO instructions. This step should not be taken until appropriate causalty recovery measures have been attempted. Special procedures that may be necessary for assisting in return of the LORSTA signal to the proper time interval are contained in RM's Supplemental Instructions or COCO instructions.

2.D.6.e. Back-up Communications Link. Us of the auto-dialer back-up communications modem between the Control Station and LORSTA can quickly cause an enormous telephone bill. Therefore, COCO may restrict use of the back-up link only when there are no personnel aboard the LORSTA. When so authorized the auto-dialer shall be disabled or otherwise patched out of the circuit during normal working hours.

f. Watch Assumption by LORSTA. The LORSTA duty technician shall assume the responsibility for the watch when a communications outage occurs. The LORSTA personnel shall also assume the responsibility for the watch. The duty technician will be required (in most instances) to assume the watch responsibility when recalled by the Control Station watchstander for an abnormal condition.

7. Loss of CALOC.

a. 15-Minute Average. The determination of LPA insertion when CALOC has failed is base upon the data from the monitor receives and interpretation of the plots. A 15-minute average is determined for each baseline's track under control of the control station. The average is determined by visually averaging the past 15 minutes of track on the recorder, as a deviation from CSTD, and annotating the strip chart by the track. The 15-minute averages from the baseline track are plotted on the form shown in Figure 2-8.

b. Bias. Each hour the average deviation from CSTD for the past hour is computed and entered in the square provided for that hour, and then added to the running summation of the past hourly averages. This summation is termed the cumulative TDE, or 'bias" and is also entered in the square provided. At the start of the log-keeping day when the new form is begun, the past day's value of bias is carried forward and the first hour algebraically added to this old value. The hourly bias value is plotted on the form as a sequence of straight lines connecting the hourly bias values. This is the bias line. At the end of the day, the daily average is computed by subtracting the biaas at the start of the day from that at the end of the day and dividing it by 24. The form must begin at the start of the GMT calendar day, or the time scale relabeled so that the far left margin coincides with the start of the Loran Log day if this is different than the GMT calendar day.

c. Inserting LPAs. The contorl station inserts LPAs into the secondary station transmissions by observing both the current deviaiton of the time-difference from CSTD (where the TD is now) and the value and trend of the bias line (where the TD was in the past). By considering both the TD and bias, the control station maintains a TD close to CSTD most of the time and maintains the average CSTD all of

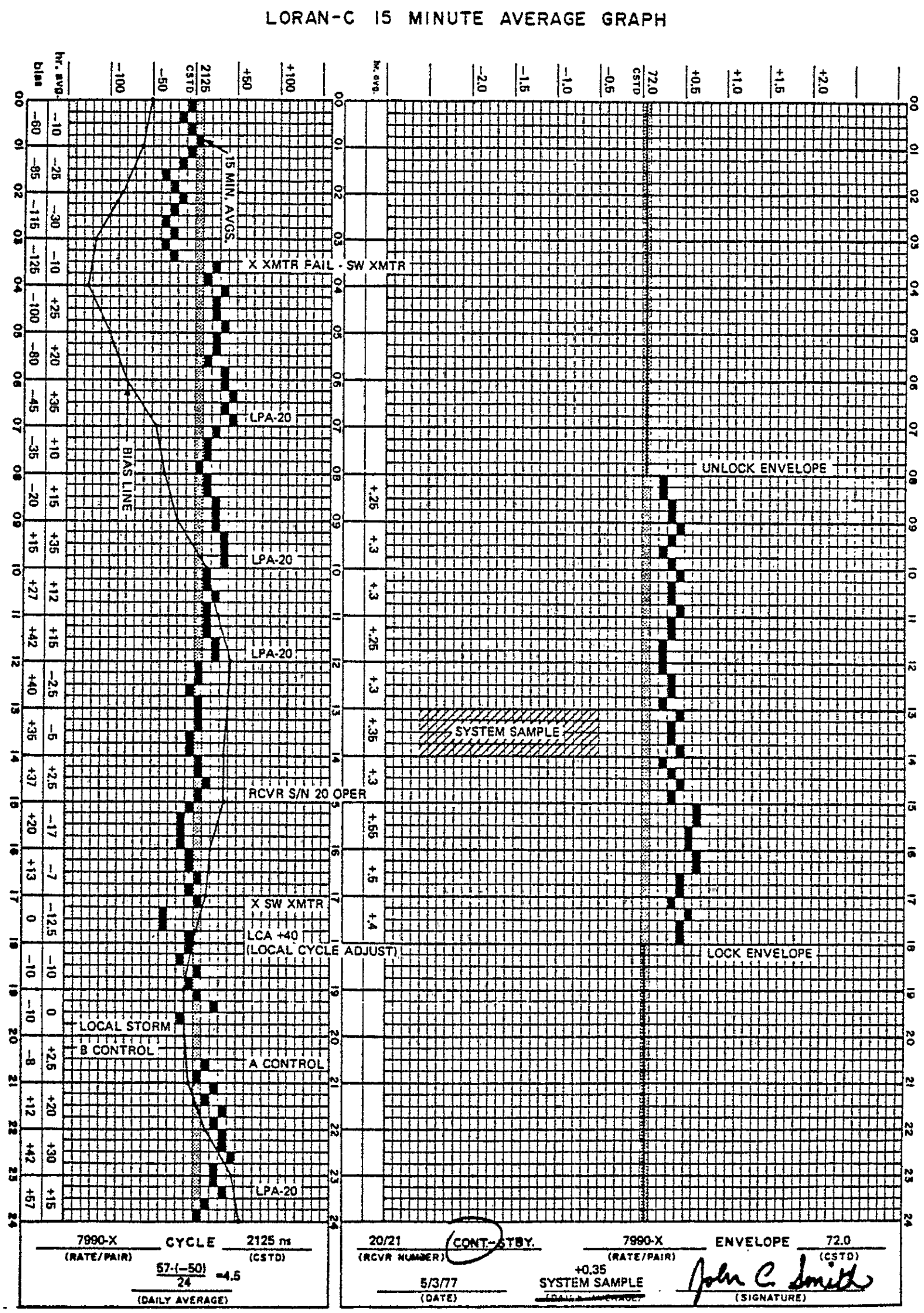


Figure 2-8. Loran-C 15-Minute Average Chart.

2.D.7.c. (Cont'd) the time. In general, the deviation of the hourly average should not be allowed to exceed 50 nsec and the bias line should be held at least within 150 nsec. These values are representative and may be modified by COCO for each baseline to reflect actual receiving conditions at the monitor site.

d. Bias Plot Example. The use of the hourly deviation and bias line is best illustrated by discussing the example shown in Figure 2-8. During the first several hours of the day, TD is within the 50 nsec deviation window and the bias is also negative and tending negative (because the present TD remains negative). Even though the TD is within the window, it has been negative for some time as shown by the bias line, and in LPA should be entered soon to reverse this bias trend. At about 0330, the secondary station changes transmitters and stabilizes above CSTD. A local adjust is not entered since this positive value of deviation is exactly what is required to bring the bias line positive. At about 0700, the rising bias line is approaching zero and a small LPA is entered to slow down the rise. The bias line is stabilized close to zero by two subsequent small LPAs at about 1000 and 1200. This situation, a small deviation and a low bias value continues until the secondary station completes transmitter repairs and returns to the primary operate transmitter at about 1700. Several 15-minute averages establish that the TD is now negative and, while again within the 50 nsec window, this negative value would quickly drive the bias line negative. At present, it is near its ideal value of zero. Therefore, an MPA is ordered to return the deviation close to zero which keeps the bias line from drifting rapidly. A local snow storm in the vicinity of the monitor site causes control to be passed at 1945, and the plot of both 15-minute averages and bias is terminated since the TD data is unreliable. Later, Alpha control is resumed and the last good value of bias is used to add to the new hourly average and carried forward. The consistent positive deviation of TD during the next several hours begins to drive the bias line positive and a small LPA is entered to slow down this trend. At the end of the day the daily offset is computed (note that bias values are algebraically subtracted) and the day's last bias value of 40 is carried forward to the new plot.

e. Operations Without CALOC. The following guidelines shall be followed for inserting LPAs:

(1) Minimum LPA Requirements. At least 4 consistent 15-minute averages are rquired to establish the present TD deviation upon which a decision to insert an LPA may be based.

(2) Bias Considerations. The present value of the bias and the trend of the bias line shall be considered before entering an LPA. In general:

(a) Deviation and Bias With Like Signs. If the deviation and the bias are of the same sign, an LPA of opposite sign should be ordered early to arrest the movement of the bias line.

2.D.7.e.(2)(b) <u>Deviation and Bias With Opposite Sings</u>. If the deviation and the bias are of opposite sign, an LPA or local adjust should not be entered (unless the deviation is very large) as the deviation is acting to reduce the bias. This difference in sign would usually be the result of a transmitting station casualty, in which case an MPA would be enterd rather than an LPA.

(3) <u>Return To Original Tracks</u>. After any casualty return to original tracks so as not to contaminate oscillator drift data.

f. <u>Control of ECD</u>. The day-to-day control of ECD rests with the transmitting station. However, long-term ECD control is based on data obtained from the CDFO-5000A monitor receivers. This data is utilized to maintain CSECD at the monitor site.

g. <u>Blink During ECD Out of Tolerance</u>. If an ECD out-of-tolerance is reported by a CDFO-5000A receiver following an equipment change at the transmitting station, then blink should be initiated and control passed to the transmitting station for resolution of the problem. However, if no equipment changes have occurred at the transmitting station, the situation is less clear and the RM's Supplemental Instructions should be consulted. Remember though, "If in doubt, BLINK!"

h. <u>Status Boards</u>. All control stations hsall maintain a status board for each chain under their control. The status board shall be easily read and in plain sight of the control watchstander's normal work station. As a minimum, the following information must be displayed on the status board:

(1) GSTD for all baselines controlled.

(2) CSECD for all baselines controlled.

(3) Present Alpha receiver foreach baseline.

(4) TMCN, AVG, CLIP, TDN, TDD, EN, ED, GN, and GD for eah station tracked by all CDFO-54000A receivers.

(5) Status of all CASREPed equipment at monitor and transmitting station in the chain.

(6) COCO, CO, and STO telephone numbers (beeper numbers).

(7) Change, activity. Any scheduled off-air, equipment changes, inspections, etc. Any periods where no routine equipment maintenance or changes are permitted.

(8) For ROS stations all current ROS parametes for each station under ROS control (shold include type of contrtol, communications status, etc.)

2.E. Administration and Support Operations

1. Training.

    a. Introduction. Loran-C station electronics and watchstanding personnel are responsible to the Commanding Officer for the operation, maintenance, and support of electronic equipment to ensure completion of the station's assigned mission. Traditionally, personnel error has been the biggest contributor to unusable time. The best solution to this problem is proper training. This chapter defines training responsibilities and requirements, and establishes procedures for administration and formal training.

    Regional Manager's Supplemental Instructions and COCO Instructions are intended to expland this section with specific requirements for watchstander and duty technician training.

    b. Individual Responsibilities. A major portion of the burden for training personnel to become qualified and proficient in Loran-C duties rests with the individual station Commanding Officer, but training responsibilities transcend the chain of command as follows:

        (1) Program Manager. The Program Manager is responsible for coordinating the Loran-C Engineering Course. The Program Manager also coordinates the training for personnel assigned to the Regional Manager.

        (2) Regional Manager (RM). The RM shall ensure that operating and training standards are met, that support resources are adequate, and training is uniform among chains.

        (3) Chain Manager (CM). The CM shall ensure personnel training, operating procedures, and technical support are adequate to exceed minimum operational standards.

        (4) COCO. The COCO reviews each station's training program and training records for compliance with current directives. The COCO advises the CM and, where appropriate, others in the station's chain of command on the adequacy of all operational training.

        (5) LORSTA or Control Station Commanding Officer. The Commandig Officer will review all periods of unusable time. If the cause was personnel error, the CO will ensure that the correct procedures are covered in the unit training program. The CO will develop additional procedures, periodic tests, or training which can be instituted to prevent a recurrence. The CO will ensure that on-the-job training of assigned personnel is continued in maintenance, support functions, and operating procedures. Training records and schedule will also be maintained.

2.E.1.b. (6) Senior Technical Officer (STO) or Senior Technician. The STO or Senior Technician will conduct, develop and maintain a technical and watchstander training program, and conduct and observe on-the-job training; for electronics personnel. The STO or Senior Technician will advise the CO regarding personnel proficiency, provide individual feedbackand update the training records.

c. Unit Training Program. Each unit will establish and maintain a continuing program of instructional training to improve watchstanding and technical proficiency. The program will conist of a minimum of two hours per week accompanied by as much on-the-job training as possible. Specific training program content will be incorporated into the RM's Supplemental Instructions. Since the unit training program will be unique to each station, the CO can tailor the program to meet immediate training needs. The following training requirements, long and short range training plans, lesson plans, and records form the basis for the unit training program.

(1) Areas of Training. At a minimum, the content will include: system indoctrination, Loran organization, station equipment operatin and maintenance (preventive and corrective), safety, watchstander duties, duty technician responsibilities, Aids To Navigation Manual-Radionavigation (COMDTINST M16500.13 (series) and RM, CM, and COCO instructions. Each of these areas will be further divided into segments in a logical order to ensure successive segments are preceded by the required underlying training.

(2) Long-Range Plans. Each unit will establish and maintain aLong-Range Trining Program in accordance with the RTM's Supplemental Instructions. The plan will reflect the training objectives for electronics and watchstander personnel.

(3) Short-Range Schedule. Each unit will prepare and promulgate a Short-Range Training Schedule in accorance with the RM's Supplemental Instructions. At a minimum, the schedule will contain the dates lessons are scheduled to be conducted, names of the assigned instructors, and topics to be covered. The schedule will be posted and a copy forwarded to the COCO for review.

(4) Records. Each unit will prepare and maintain an individual training record fore ach technician or watchstander. The USCG Training Record (CG-5285) will be used for Coast Guard personnel (also recommended for use for other personnel). Existing record folders need not be converted to training folders if they meet the content requirements listed below. However, as new personnel report, the folders will be used.

(a) Personnel History Form. This form will provide a brief but complete history of the individual's previous formal training and correspondence courses.

2.E.1.c. (b) Record of Practical Factors (CG-3303C, series). These forms are applicable only to U.S. Coast Guard personnel and will be annotated as the individual demonstrates proficiency in an area.

(c) Attendance Sheet. A listing (including dates) of all lessons attended or instructed by the individual. Include test scores if applicable.

(d) Qualifications. A copy of any qualification check-off list completed by the individual will be included as well as copies of any letters certifying their qualification.

(e) Miscellaneous. Any other material the command feels is relevant and should be included.

(5) Lesson Plans. Lesson plans will be developed for each topic area. The lesson plan is a guide for the instructor to present the subject matter in a logical order and asist in student comprehension. Each lesson plan will contain a brief introduction, objectives, presentation, a brief summary, an examination, quiz, or demonstration of the skill or knowledge objective. U.S. Coast Guard staffed stations must place emphasis on the Technical Performance Factors in Table 7.5.1. of Coast Guard Electronics Manual (COMDTINST M10550.13). This emphasis is to ensure that Electronics Technicians progress in a timely manner from Loran Apperentice to Journeyman to Master Technician. The on-the-job training portion of the U.S. Coast Guard station's program will ensure that appropriate ET Practical Factors are completed.

(6) Billet Qualification Codes. Assignment officers use the billet qualification codes on the Personnel Allowance List (PAL) to identify training needs for Coast Guard personnel being transferred. Commanding Officers scheduled to have incoming personnel are encouraged to contact the assignment officer if the station's immediate needs are different from the qualification codes on the PAL. Commanding Officers will review their PAL qualification codes annually and update as station requirements change.

d. Formal Loran Training.

(1) Introduction. Formal Loran Training refers to training available to an Electronics Technician on a particular piece of Loran equipment or sysltem. This type of training is usually requested for an individual in conjunction with a Permanent Change of Station (PCS) move. These courses range in length from 5 to 15 days and are otulined in the latest edition of Training Center New York, Electronics Schools Branch Schedule and Course Description. A predetermined combination of courses is available to qualified personnel according to the type of station to which they are being assigned. Commanding Officers of units scheduled to receive personnel will coordinate this

2.E.1.d. (1) (Cont'd) (pipeline) training with the individual reporting, the individual's current Commanding Officer, Commandant (G-PTE), and the enlisted assignment officer (Commandant (G-PE)). The current Commanding Officer of personnel being transferred should cooperate with all requests for pipeline training.

(2) Host Nation Training. All host nation requests for Loran-C training will be directd to the appropriate Host Nation trianing coordinator.

(3) Trained Personnel. The following are the minimum number of qualified (formally trained) personnel for each type of facility.

FACILITY	EQUIPMENT	NO OF TRAINED PERSONNEL
LORSTA		
1.	Transmitter Type	2
2.	Timing and Control Equipment	2
3.	Remote Operating System (course TBD) (for Remote Operating System equipped units).	2
CONTROL STATION		
1.	Primary Chain Monitor Set (station with CDFO-5000 only)	2
2.	Prima;ry Chain Monitor Set (user course)	3
3.	Remote Operating System (Course TBD) (for Remote Operating System equipped Control Sites)	3
LORMONSITE		
1.	Primary Chain Monitor Set	2

e. COCO Training. Traditionally, assignment as COCO has been made based on the individual's experience, background, and training. Individuals selected for COCO assignments have an extremely wide range of administrative duties and responsibilities over many varied types of equipment. All COCO s or prospective COCOs will obtain as much training (or equivalent experience) as possible. The CMs will assess a prospective COCO's training needs when orders are received (or before if practical) and will assist in arrangin for pipeline or other necessary training. The COCOs will assess their own training needs every six months and make recommendantions to the CM for further training. The following recommended list is considered standard for COCO qualificaiton:

(1) Qualified on all operating equipment within the chain. See section 2.B.3.g.

(2) Loran Systems course.

2.E.1.e. (3) Loran-C Engineering course.

(4) Officer Leadership and Management course. (USCG only)

(5) Subtance Abuse course. (USCG only)

2. Awards.

a. Purpose. Official recognition of outstanding performance must be timely and meaning to the recipients. Unlike may other fields of endeavor, outstanding Loran-C operations are characterized by performance over the long-term. To be considered for an award under the auspices of the Medals and Awards Manual, COMDTINST M1650.25, based solely on long term performnace (no adverse or special circumstances) could be a very long time indeed. By the time the award is proposed, approved, and distributed, most of the personnel involved may be departed from the unit. To recognize shorter, but still significatn periods of outstanding performance, each RM may set up an awards program. Guidelines for each type of award, its criteria, and recipients are discussd in the following sections.

b. Responsibilities

(1) Coordinator of Chian Operation (COCO). The COCO monitors station, baseline, and chain performance to ascertain when award criteria have been met. COCO reports all award-level performnace to the CM.

(2) Chain Manager (CM). The CM reviews, evaluates, and verifies COCO's reports for accuracy. If warranted, the CM recommends issuance of th award by the RM.

(3) Regional Manager (RM). The RM considers the CM's recommendation. If the recommendation warrants approval, the RM issues the award.

c. Definitions. Some of the more important terms used in the award guidelines are discussed below:

(1) Transmitting Station Operations Award. An award issued by the RM and based solely on the performance of the transmitting station.

(2) Control Station Operations Award. An award by the RM and based solely on the performance of the control station.

(3) Baseline Operations Award. An award issued by the RM and based on the performance of a particular baseline pair and its control station.

2.E.2.c. (4) Chain Operations Award. An award issued under the auspices of the Medals and Awards Manual. COMDTINST M1650.25. The award will be based on the performance of the entire chain over a specified period. If an award is authorized, host nation statins will receive the "equivalent" Public Service Award.

(5) Lapse of Control. One of the entities in a Loran-C chain,i.e., master (Bravo control), the secondary (Delta control), or the control statin (Alpha control) must be controlling the baseline at all times. If, through personnel error or equipment failure, control is not properly passed, there may be a period in which no entity is controlling the baseline. This period is considered a lapses of control and requires COCO notification.

(6) Unusuable Time (UUT). For award purposes any period of time during which the Loran signal is unusable shall initially be considered UUT regardless of the cause. This includes all off-air time whether authorized or emergency. The RM shall evaluate the UUT and may exclude any period(s) which, in the RM's opinion, should not be considered in determining a unit(s) performance. While evaluating UUT, the RM should be on the alert for excessive or unnecessary Authorized Unusable Time.

d. Award Guidelines. The premise for the following "operations" awards is to recognize performance by Loran- C facilities which results in user signal availability well above the established minimum performance levels. RMs may modify or add to the criteria outlined below to prevent a proliferation of operations awards. Generally, RMs should be authorizing performance awards for only about 5% of their respective Loran units during a one-year period. Also, RMs shall be extremely prudent in authorizing any award where signal availability is less than minimum performance levels (99.9% for LORSTA, 99.7% for triad).

(1) LORSTA Operations Award.

(a) Criteria. LORSTA achieves 180 (or more) consecutive days of at least 99.99% user signal availability. This equates to no more than 25 minutes of UUT during a 180-day period.

Note: The award period consists of any 180 consecutive days not covered by antoher LORSTA Operations Award.

(b) Recipients.

1. If not ROS equipped, only the qualifying station.

2. If ROS equipped, both the qualifying station and the control site exercising operational ROS control.

2.E.2.d. (2) Control Station Operations Award.

(a) Criteria. The control site achieves 180 (or more) consecutive days of operatons without:

1. Causing, partially or wholly, any periods of out-of-tolerance without secondary blink (OTBK).

2. Causing, partially or wholly, more than 10 minutes of unnecessary secondary blink on any single baseline. Total time on all baselines not to exceed 25 minutes during the award period.

Note: The award period to consist of any 180 consecutive days not covered by another Control Station Operations Award.

3. Causing, partially or wholly, more than 1 lapse of baseline control on any single baseline.

(b) Recipient. Qualifying control station.

(3) Baseline Operations Award.

(a) Criteria. Considering exclusions, a master-secondary pair achieves 60 (or more) days of 100% operations.

Note: The award period to consist of any 60 consecutive days not covered by another Baseline Operations Award.

(b) Recipients.

1. Master LORSTA.

2. Secondary LORSTA.

3. Responsible control station.

(4) Chain (Unit) Operations Award. When the performance of an entire chain meets the following criteria, the cognizant RM may evaluate the chain for a Coast Guard unit award under the auspices of the Medals and Awards Manual, COMDTINST M1650.25. This is just a guideline, and meeting the criteria doensn't mandate an award, only that the chain may be considerd for an award. As with the other awards, the RM may modify orr expland the criteria. Meeting the criteria below will be easier for some chains than for others.

(a) Criteria. Sixty consecutive days of 100% chain operations.

2.E.2.d.(4) (b) Recipients.

1. The control station, COCO, and all LORSTA's in the chain.

2. Other units as determined by the RM.

(5) Unit Awards. Because of special circumstances, events, or exceptional performance, a Loran-C unit(s) may be deserving of special recognition. The unit(s) may or may not qualify for one of the above operations awards during this particular period. On these occasions, the COCO may initiate recognition via official correspondence (e.g., letter from District or Area Commander), or recommend a Coast Guard unit award under the auspices of the Medals and Awards Manual, COMDTINST M1650.25.

(6) Personal Awards. The nature of Loran -C operations requires a team effort to achieve outstanding performance. Except under very exceptional circumstances, recognition of individuals solely on the basis of extended outstanding Loran-C operations (e.g., perfect baseline operations for six months) is inappropriate. Such recognition will be of the unit and not the individual. No degradation of individual effort is intended. However, awards for individual effort will relate only to the individual's accomplishments. When considering an individual for an award, overall performance of the unit to which attached may be a factor, but not the sole justification for award.

Many commands review individual performance for consideration of awards primarily upon transfer or retirmeent of the individual. Review of performance at this time is reasonable and should continue. Commands should, however, ensure outstanding performance is recognized when it occurs. Don't wait for the member to depart.

(7) Award for Host Nation Stations. Host nation stations are not eligible for awards under the same auspices as the USCG stations. Use the equivalent Public Service award when their performance would normally rate a USCG medal or ribbon.

3. Reports and Notices.

a. Notification of Users and Higher Authority.

(1) Initiating Blink. The user is entitled to presume that the transmissions are within the advertised tolerances. The absence of any information to the contray supports this presumption. Secondary blink (or off-air) is used to reapidly notify users that a signal is unusable for navigation. Secondary blink should be initiated when master or secondary:

(a) TD is out-of-tolerance

(b) ECD is out-of-tolerance

2.E.3.a.(1) (c) phase code is improper

(d) GRI is improper

(e) Power is less than half of the specified output power

(2) COCO Initiated Notices. From the LORSTA and control station evaluation of a casualty, the COCO must make a determination of who to notify and the procedure for the notification of higher authority and users. In addition to blink, the user and various levels of the operational chain of command will be notified when:

(a) There has existed for 30 continuous minutes or more any signal irregularity or out-of-tolerance condition, including low power, or a condition exist that makes it obvious that the signal will be OOT more than 30 minutes.

(b) Intermittent signal irregularity or out-of-tolerance conditions have resulted in 30 minutes or more of unusable time in one hour or less.

(c) Irregular or out-of-tolerance conditions exist for longer than two minutes without secondary blink.

(b) A condition that has been previously reported is corrected.

(e) Jumps in transmissions with respect to UTC occur.

(f) Changes in the master oscillator frequency occur.

(g) Failure and subsequent change of master operate oscillator take place.

These conditions will require COCO to notify, by priority message, the appropriate Address Indicator Group (AIG) for the RM, CM, and U.S. Naval Observatory (USNO). The AIG may include district offices, commercial civilian firms and other U.S. or foreign agencies as addressees. It may be appropriate to requet a Notice to Mariners, Notice to Airmen, Notice to Shipping or other notifications. The AIG should identify the rate and station which has the irregular condition, duration and cause of the anomaly (state cause only if not personnel error). If the event is ongoing, give an estimate of time expected to return to normal operations. If a Notice to Airmen, Mariners, or Shipping is requested, a date and time for termination of the notice is appropriate.

(3) Authorized Unusable Time (AUTM Notification). When Authorized Unusable Time (AUTM) is scheduled, a notice to users (AIG) is appropriate. The users should be contacted thirty days in advance, where possible, soliciting their objections. An alternate date should be listed whenever possible so a second solicitation need not be made if objections are received (or if a

2.E.3.a (3) (Cont'd) foul weather date is appropriate). Several days before the off-air another AIG should be sent reminding users that the off-air will occur and what, if any, changes in times may be expected.

(4) Emergency Unusable TIme (EUTM) Notification. An Emergency Unusable Time (EUTM) may be required to effect repairs to station equipment when failure to accomplish repairs as soon as possible will jeopardize the station's operational mission. The procedure for advertising and granting EUTM is the same as for AUTM, except that the advance notice is generally shorter (less than ten days). In some rare instances there may not be any advance notice at all; however, a message should be sent during the event (off-air) if the station is expected to be off-air for over thirty minutes.

b. Casualty Reports.

(1) General. Casualty Reports (CASREPs, CASCORs and SITREPs) shall be submitted in accordance with current policy. Casualty reports are submitted to notify higher echelons of problems. When a mission-essential piece of equipment (including all operate and standby equipment) has failed and cannot be repaired within four hours, COCO shall be advised by Priority message. Information addressess should include CM, RM, and the appropriate District or Host Nation Agency. When the equipment failure has been corrected, a Routine message should be sent to the same addressees that received the original report.

(2) Corrective Maintenance. Corrective maintenance shall continue until the equipment is restored to full operational capability or it has been determined that repairs are beyond the capabilities of station personnel. When a transmitting station has control during a casualty, the watchstander or duty technician must quickly assess the situation and determine if higher notification is necessary.

c. Notification Of Senior Station Personnel. The station Commanding Officer will establish the content, criterion, and form of watchstander notification of senior station personnel, and must document this process. At a minimum, the process must:

(1) Provide specific and correct contact information, e.g., telephone or pager numbers, etc., for all personnel to be contacted.

(2) Provide specific direction as to station personnel to be contacted and when (e.g., STO (or ETC)) to be contacted if the station experiences five minutes of unusable time; Commanding Officer to be contacted if 15 minutes of unusable time occurs, etc.

(3) Provide specific direction for contacting COCO. This information will be included in COCO's instructions.

2.E.3.d. Station Daily Report Of Loran-C Operations.

(1) System Sample. System sample, a one-hour period representative of typical operations, is the primary data source for the Loran Operations Information System (LOIS). During a one-hour period every day, data are observed, processed, recorded and prepared for transmission in a daily operations report to the COCO. The data for collected simultaneously for each station in the chain during system sample. Normal control procedures only should take place in the hour preceding the system sample. Attempts to place the system "on the number" will reduce the statistical reliability. This is the only operations report required by the individual stations. The COCO will provide the stations with detailed instructions concerning content and format of this report. The station report should include the following:

(a) Sample of phase TD for each monitored baseline in nanoseconds (nsec). This sample is the hour average during the system sample period taken from the Austron receiver or operate monitor receiver.

(b) Peak-to-peak excursions of the phase TD, in nsec, during the system sample.

(c) Sample of control station envelope TD for each monitored baseline or ECD, in microseconds. This sample is the hour average taken during the system sample period from the operate timer and receiver at the control station or the ECD strip chart recording.

(d) The control station also reports for each baseline:

1. The daily average of 15-minute averages taken from the operate timer, receiver ECD (microseconds) and phase (nsec).

2. Number and algebraic sum of LPAa (nsec).

3. Presently assigned ECD (microseconds) and the number of changes during the previous 24 hours.

4. Periods of master and secondary blink, off-air and out-of-tolerance. Periods of blink of less than 60 continuous seconds are not counted, but should be recorded in the daily log as "blink momentary."

(e) Transmitting stations also report:

1. TINO (TIC reading in us).

2. Number of valid commands, blink time and off-air time as indicated on LRE counters during previous 24 hours (counters should be reset to zero after the readings are taken).

2.E.3.d.(1)(e)

3. Total change in phase over the previous 24 hours as read either from the phase recorders or the LRE phase resolver dials for the standby oscillator and oscillator 3. (The difference in LRE phase resolver dial readings from one day to the next must be multiplied by 2 to convert the readings to nanoseconds).

4. LPSs entered while in Delta control (not local adjusts).

5. Itemized red-alarm failures.

6. Cesium standard C-field or microstepper adjustments (record accomplishment, serial number, and final dial reading) if applicable to the report period.

7. Peak voltage of the first pulse as read from the EPA.

8. Valve of total power amplifier (PA) cathode current if transmitters have been switched during the report period and a station is on a different transmitter at the end of the report period than at the beginning of the report period.

(f) All stations also include a remarks section under which would be reported any inoperative equipment, major corrective maintenance, communications failures and other noteworthy information.

e. COCO Reports Of Loran-C Operations.

(1) Weekly Reports. The system sample, a one-hour period representative of typical operations, is the primary data source for the Loran Operations Information System (LOIS). During this time, data are collected and forwarded in a daily operations report to the COCO. The COCO processes the LOIS data and determines the statistical significance at least once a week. Specifically, the data reveals the quality of receiver tracks, the quality of the control stations TD control, and the overall quality of the chains performance. The COCO will use this LOIS programs to compute and record the following weekly statistics:

(a) Synchronization Data (for each baseline).

1. The mean and standard deviation of: control station phase sample p-p excursion, daily average of control station 15-minute averages, control station phase sample deviation from the CSTD and master and secondary station phase sample p-p excursions.

2. CDFO-5000A equipped stations: the ECD sample from the Alpha-1 monitor site and transmitting station ECD sample pair. Because of its importance, check the phase computation twice to ensure accuracy.

2.E.3.e.(1) (b) Oscillator Data (for appropriate stations).

1. The current estimate of the frequency offset of each oscillator (-~) in nanoseconds per day.

2. The standard deviation of the estimate of the frequency offset ((1). (For the operate oscillator, this is the standard deviation of the phase sample record, which is the daily LPA sequence of the baseline).

3. The total number of daily samples (N) forming the data record for the oscillator. For multi-week analysis, this is the number of days since the last correction to the oscillator or since its data record was zeroed.

4. The first-lag autocovariance coefficient (p) for each oscillator.

(c) Envelope Date.

1. The optimum time shift to the nearest 0.25 microseconds and the resulting rms percent error.

2. Droop (DP)% - (max - min) x 100 max

(2) COCO Review of Weekly Reports. The COCO shall then total the Chain Performance Quality figures for the week and review all of the weekly computations in two steps. First, to ensure that there are no mechanical errors, the COCO shall compare the current week's statistics with the previous week's and with the actual raw data (use the plots where appropriate). Abrupt changes in oscillator offset, a standard deviation that is far larger than its corresponding mean, or a mean that bears no relation to the data sequence recorded are obvious errors that should be looked for. After ensuring that the statistics are numerically reasonable (i.e., they could come from the raw data), the COCO shall consider each in relation to the chain's operation and individual transmitting station and control station performance. Minimum performance specifications and required actions in the event of failure to meet the specifications are given elsewhere in this chapter for certain critical system parameters.

(3) Minimum Weekly Report Requirements. After reviewing the weekly LOIS computations, COCO shall prepare the weekly report, send it via routine precedence message to the CM on Tuesday, as outlined in the following subparagraphs. The CM will provide the COCO detailed instructions concerning report format.

(a) Baseline Reports.

1. The largest deviation from the phase CSTD of the control station system sample for the past week (nsec).

2.E.3.e.(3)(a) 2. Total minutes of unusable time for each baseline.

3. The number and algebraic sum of LPAs (nsec).

4. The number of changes to ECD and the current value (~sec).

(b) Station Reports.

1. The lowest peak voltage of the first pulse for the week.

2. The rms percent pulse shape error.

(c) Oscillator Information. The stations oscillator designation and serial number for any C-field correction or microstepper adjustment entered including final dial readings.

(d) Excessive Rho. The station and oscillator serial number for any unit with-more than 30 days' data whose rho exceeds +0.5; list

(e) Remarks. Remarks to include major equipment failure, significant changes, major maintenance, and a brief summary explanation of any unusable time exceeding five minutes in one single period.

(4) Monthly Reports. The Monthly Report of Loran-C Chain Operations will be prepared by the COCO and submitted to the Chain Manager. For purposes of this report the month shall be defined as beginning on the first Tuesday of the month. Thus every month will consist of either four or five weeks and hence be compatible with the LOIS data which is subtotaled in weekly increments. The report shall be forwarded by mail and shall be enroute by the end of Friday of the week beginning the new month, unless alternative arrangements have been made with the Chain Manager. COCO shall retain a file copy. The COCO shall also submit one copy of each of the LOIS Synchronization, Oscillator and Pulse Shape Data sheets for the month. These will be retained by the Chain Manager on a long-term data base. The RM will provide the COCO detailed instructions concerning monthly report format.

(5) Monthly Report Contents. The first step in the preparation of the monthly report is the computation of LOIS statistics for the period of the report. The COCO shall use the Multi-Week Analysis program to combine all four or five weeks of data from the LOIS data sheets to arrive at the same monthly parameters as tabulated weekly. These statistics are entered in the blocks provided at the bottom of the LOIS data sheets. In addition, the COCO shall compute a two-month master-secondary covariance coefficient, following the Multi-Week Analysis program instructions. Most of the data for the report is determined from LOIS calculator processing. While in some cases three and four place significance must be carried in the LOIS data history, this is not generally required in the report. The complete report is

2.E.3.e.(5) (Cont'd) prepared according to the following guidelines and example. The figure in parenthesis beside each parameter indicates the number of significant figures to the right of the decimal point to be reported. All phase information associated with time difference or oscillator statistics is to be reported in nanoseconds.

(a) Synchronization.

1. Control station D(O)/C(O)/o(O): D is the monthly mean of the daily averages of the 15-minute CALOC phase averages at the control station. D should be quite close to the CSTD. C is the monthly mean of the daily 2hase system samples at the control station. Note that C is obtained by adding the LOIS computed mean phase deviation to the CSTD. C should be close to the CSTD. o is the standard deviation of C.

2. PP-1(O)/PP(O): PP-1 is the past month's mean p-p excursions of the phase TD at the control station during the system sample period. PP is the current month's value.

3. M(O)/S(O)/p1(1)/p2(1): M is the monthly mean of the sample phase TD at the master station for the indicated baseline. S is the monthly mean of the sample phase TD at the secondary station for the same base line. p1 is the covariance coefficient of the master and secondary phase TD samples for the month, and p2 is the covariance coefficient for the past two months.

4. om(O)/os(O)/PPm(O)/PPs(O): om is the standard deviation of the sample phase TD at the master station, and os is the corresponding statistic for the secondary station. PPm is the monthly mean p-p excursion_of the sample phase TD at the master station, and PPs is the corresponding statistic for the secondary station.

(b) Envelope.

1. ECD/E(1)/o(1)/p(1): ECD or E is the monthly mean of the sample ECD at the control station. o is the standard deviation of the ECD sample. p is the correlation coefficient for the ECD sample at the control station and the secondary ECD sample.

2. ECD(1)/N(O): ECD is the mean secondary station ECD value for the month. N is the total number of changes made to the assigned secondary station ECD for the month.

3. V1(O)/Ic1(1)/DP1(O)/ %(1): V1 is the lowest peak voltage of the first pulse from transmitter 1 for the month. Ic1 is the total PA cathode current in amperes, associated with V1. DP1 is the worst droop (in percent)

2.E.3.e.(5)(b) 3. (Cont'd) for transmitter 1 for the month. %(1) is the largest rms percent pulse shape error in transmitter 1 for the month.

4. V2(0)Ic2(1)/DP2(0)/%(1): These are the same parameters as above for transmitter 2.

(c) Oscillators.

1. OP N(0)/(0)/(0)/ (1): N is the total number of samples forming the data record for the operate oscillator at the end of the month. This is the number of days since the last correction to this oscillator, or since its data record was zeroed. is the current estimate of the frequency offset for the oscillator in nsec per day. is the standard deviation of the estimate of the oscillator frequency offset. is the first-lag auto-covariance coefficient for the operate oscillator.

2. STBY same: These are the same parameters as above for the standby oscillator only the measurements are referenced to the Operate Oscillator.

3. OSC 3 same: These are the same parameters as above for oscillator 3 only the measurements are referenced to the Operate Oscillator.

(d) Performance Quality.

1. BKm(0)/BKs(0)BTH(0): The number of minutes of master blink, secondary blink and both station blink for the baseline for the month, exclusive of off air times.

2. OT(1)/UTM(1)/%(2): OT is the number of minutes the baseline was out-of-tolerance, for any reason, without secondary station blink. UTM is the total baseline unusable time for the month, computed as: UTM = OT + BKs + OF (where authorized off-air and authorized unusable are included in the appropriate category). % is the percent of the month that the baseline was unusable.

3. OF(1)/AUTM(1): OF is the total off-air time for the month. AUTM is the total authorized unusable time for the month.

2.E.3.e.(5)(d)

4. BC(0)/DC(0)/%(2): BC is the number of minutes the baseline was in Bravo control for the month. DC is the number of minutes the baseline was in Delta control for the month. % is the percent of the month that the baseline was in Alpha control and is calculated as:

$$\%A = \frac{(1 - BC + DC) \times 100}{\text{total time}}$$

5. Non ROS (0)/%(2): Non ROS is the total number of minutes the baseline was in local control at the transmitting station. % is the percent of the month that the LORSTA was in ROS control.

(e) COCO Remarks.

1. The COCO should comment on any major abnormal condition occurring during the month or endemic condition requiring correction or assistance. Additional sheets may be attached to the report as necessary. Typical subjects should include: major or repeated equipment failures, operational or control problems, personnel problems, prime power instabilities, communication problems, failures to meet assigned performance standards, excessive equipment maintenance, and interference problems.

2. The Chain Manager shall review the monthly report and respond to any specific COCO comments that require assistance or policy direction. In addition, the CM should advise COCO on any trends or potential problems revealed by study of the performance statistics, especially as compared to the historical data base for the chain. The CM should forward the Monthly Report of Chain Operations to the RM, together with any pertinent comments and recommendations.

(f) Analysis of Loran-C Unusable Time.

1. Occasionally, it's necessary for RMs and other potential users to analyze Loran-C availability. In addition to the Performance Quality data in the monthly report, COCOs should maintain estimates of Mean Time Between Failures (MTBF) and Mean Time To Repair (MTTR). Systems failure information may help system managers to:

a. Determine the ability of the Loran-C navigation system to meet its requirements.

b. Identify high failure components (i.e., primary power, transmitters, etc.), and justify improvements or replacements.

2.E.3.e.(5)(f)

1.c. Identify training (operational and technical) deficiencies.

2. The detailed system failure (unusable time) data will be reported by each COCO and included with the Monthly Report of Chain Operations in the form outlined below:

a. One or more coded alphanumeric character strings for each unusable time period on each baseline. Table 2-3 contains a listing of failure codes to be used.

b. Each string containing station responsible, time and duration information, and primary cause.

c. Multiple strings, containing "continuation" indicators, provide capability to report the various primary causes usually leading to extended unusable time periods without perturbing MTBF and MTTR statistics on failures in general.

(g) System Failure Data. The detailed system failure (unusable time) data will be reported and included with the monthly report in the form outlined below.

1. One or more coded alphanumeric character strings for each unusable time period on each baseline. Table 2-3 contains a listing of failure codes to be used.

2. Each string containing station responsible, time and duration information, and primary cause.

3. For each baseline, the report data fields are defined as below:

a. Field 1: one character indicating the baseline for the unusable time (W,X,Y, or Z).

b. Field 2: One character indicating the station primarily responsible for the unusable time (M for master, S for secondary, C for monitor and/or control).

c. Field 3: Nine characters indicating the date-time-group (Zulu) and month of the start of the unusable time period (e.g., 111223OCT). Events that are begun by one cause and are extended by another (e.g., prime power failure for three minutes and watchstander error for 20 minutes) will be entered as two events.

d. Five characters indicating duration of the cause of the event. Momentaries should show up as zero.

2.E.3.e.(5)(g)

3.e. Field 5: Three charaters indicating the primary cause of the unusable period. The codes for the various causes are given in tabular form in Table 2-3; the first character is a numeric indicating "area," the second is an upper case letter indicating "basic sub-area," and the third is a lower case letter indicating "specific sub-area."

f. Field 6: One character indicating type of unusable time; leave blank if unauthorized; insert A for authorized, E for emergency, or D for DESLOT.

4. For each receiver, the report data fields are defined as below:

a. Field 1: R.

b. Field 2: Receiver number of Baseline.

c. Field 3: Nine characters indicating the date-time-group (zulu) and month of the start of the unusable time by one cause and are extended by another (e.g., prime power failure for three minutes and watchstander error for 20 minutes) will be entered as tow events.

d. Field 4: Five characters indicating duration of the cause of the event. Monmentaries should show up as zero.

e. Field 5: Three characters indicating the primary cause of the unusable period. The codes for the various causes are given in tabular form in Table 2-3; the first character is a numeric indicating "area," the second is an upper case letter indicating "basic sub-area," and the third is a lower case letter indicating "specific sub-area."

f. Regional Manager Quarterly report of Loran-C Operations (RCS-G-NRN-15235). From the weekly and monthly reports, the RM prepares a quarterly report of Loran-C Operations and sends it to the Program manager. Reports are to be submitted to the Program Manager, in prescribed format, within 60 days after the three-month period ending the Loran-C months of December, March, June, and September.

g. Abnormality Analysis.

(1) Purpose. the procedures outlined below are intended to improve the response time to an unusable time analysis. This permits more efficient use of LORSTA, Control Station, COCO and RM time by deleting (in some instances) the need for a complete abnormally report. Our aim is to not analyze the UUT of anything but an unusual or important event.

2.E.3.g.

(2) When To Do Abnormally Analysis. An abnormality analysis is required by COCO when:

(a) Any period of out-of-tolerance without blink is excess of five minutes or

(b) Any period of out-of-tolerance with blink or unscheduled off-air exceeding one hour.

(3) Message Requirement. COCO will report any abnormality requiring analysis by message within five working days of the event to the RM and CM. The message will include the following information:

(a) Subject line (station or baseline designation and type of event; e.g., 7930 Z of-air).

(b) Date and times of event, broken down as off-air, out-of-tolenance without blink (OTBK), and total UUT.

(c) Summary of events.

(d) Corrective action taken.

(e) Any equipment that remains CASREPed.

(f) Recommendation of detailed analysis.

Based on the summary analysis, the RM will determine if an abnormality analysis is required and advise the COCO of the requirement.

(4) Letter Reports. When letter reports are required, a brief narrative followed by facts, opinions, and recommendations is satisfactory. Enclosures supporting the facts and opinions should be included. Enclosures should normally consist of watchstander and duty technician statements, photocopies of charts, plots or log entries, and other pertinent information. Reference should be made to all Loran-C chain instructions. Original charts need not be submitted, but photocopies must be legible. All enclosures must be on 8.5 by 11 - inch paper; larger paper is unacceptable.

(5) Forwarding of Reports. The RM may feel the incident warrants the attention of the Program or support Manager. A copy of the investigation with attached comments may be forwarded to the PM for further discussion and dissemination.

(6) Negligent Personnel. If an abnormality analysis is in progress and COCO feels that there is sufficient evidence of negligence, the RM should be contacted. A decision will then be made to continue with the current investigation, conduct an informal investigation, take other action under the guidance of the UCMJ, or take other appropriate action in the case of host nation personnel.

Table 2-3 System Unusability Codes

FIRST CHARACTER	SECOND CHARACTER	THIRD CHARACTER
1. Transmitter	A. Tube Type	a. control circuitry
		b. power supply
		c. low power unit - tube
		d. low power unit - other component
		e. high power unit - tube
		f. high power unit - other component
		g. auxiliary equipment - pumps, blowers, inter - locks, etc.
	B. Blank	
	C. Coupler	a. relay failure - high voltage relay
		b. relay failure - low voltage control ralay
		c. tuning coil, or other primary component
		d. auxiliary-coupler interlock, fire detection system shuts down both transmitters erroneously
		e. Pearson current transformer
	D. Dummy Load	a. load bank
		b. Pearson current transformer
		c. other-dummy load interlock, etc.
	E. Solid State	a. half-cycle generator (HCG)

b. PATCO #1

c. PATCO #2

d. TOPCO

e. signal distribution amplifier (SDA)

f. control rack

g. output network

h. coupler network

i. switch unit

j. prime power unit

k. power phase selector

l. other

NOTES:

1. Dual transmitter failures that do not fit under C. above, should be reported as two separate "continued" failures contributing to one period of unusuable time.

2. Momentary off-airs resulting from transmitter failure with the TAC bringing up the standby normally, or momentary overloads, are assumed to be normal operating conditions. Similarly, routine scheduled transmitter switches are also normal operating conditions, if they result only in momentary breaks in service. Thus, these conditions will not be reported in unusuable time statistics unless they result in greater than one minute of unusuable time.

3. The high power unit of the AN/FPN-42/44/45 transmitter is that portion of the circuitry encompassing the 2nd IPA tubes and later stages. In the AN/FPN-39 equipments, these stages are physically located in the separate high power unit enclosures.

FIRST CHARACTER	SECOND CHARACTER	THIRD CHARACTER
2. TIMING AND CONTROL EQUIPMENT	A. Time Base	a. frequency standard
		b. micorstepper
		c. phase resolver
		d. distribution amplifier
		e. frequency standard rack patch panel
		f. Timer #1
		g. Timer #2
		h. Timer Control Unit (in AN/FPN-54A rack)
		i. RCI (misfire, or other failure - not communications or watchstander)
	B. Transmitter Control Set	a. PGEN #1
		b. PGEN #2
		c. TAC-failure to detect transmitter off airor low power, actual TAC failure, not technician error in calibrating
		d. TAC-once condition detected, failure to bring up standby transmitter, TAC failure not transmitter
		e. interface chassis, cabling, emergency stop switch (failure, not erroneous activation)
		f. emergency stop switch, accidental (not watchstander error) application

		g. EPA-ECD measurement
		h. EPA-peak measurement or reference envelope failure
	C. Auxiliary	a. Receiver-not ninth pulse blink detector
		b. antenna coupler
		c. notch filters
		d. multicoupler
		e. signal splitter
		f. UPS, battery
		g. UPS, control (circuit breaker, charger, etc.)
		h. 312D
		i. 312D and UPS, battery
		j. 312D and UPS, control
		k. SAU
		l. ARU/RAU
		m. TIC/TIC panel
		n. strip chart recorder
3. COMMUNICATIONS	A. Landline	a. common carrier
		b. terminal equipment control station
		c. terminal equipment transmitting station
		d. terminal equipment monitor site
	B. Two Pulse Communications	a. modulator
		b. demodulator-printed circuit (TPC) module in receiver

		c. Receiver itself-not due to receiving antenna, system or demodulator board
	C. Radio (HF)	a. RATT or voice, transmitter side (i.e., transmitter, keyer, etc.)
		b. RATT or voice, receiver side (i.e., receiver, converter, etc.
	D. Other	a. Ninth Pulse blink detector board
		b. Ninth Pulse blink detector inoperative due to low SNR, high false alarm, rate, etc.
		c. SelCall encoder
		d. SelCall decoder
4. MONSITE MONITOR EQUIPMENT	A. RF system	a. antenna
		b. coupler
		c. notch filters
		d. cross rate blanker
		e. multicoupler
		f. cables
		g. ground system
		h. other
	B. PCMS	a. receiver failure
		b. computer halt
		c. computer fail
		d. UPS
		e. TTY failure
		f. tech maintenance
		g. ops inspection

		h.	remote calibration
		i.	other (e.g., training
C.	TTY Circuit	a.	landline failure
		b.	MONSITE modem
		c.	Control Station modem
		d.	MONSITE local loop
D.	Control Station Equipment	a.	TTY failure
		b.	CALOC computer
		c.	UPS
		d.	6019A failure
		e.	local loop/CLIP
		f.	other
E.	Power	a.	commercial interruption
		b.	UPS fail after comms outage
		c.	misc.
F.	Personnel	a.	tech error/MONSITE
		b.	tech error/Control Station
		c.	MONSITE tech response delay due to other maintenance obligations
G.	Environment	a.	lightning
		b.	high winds
		c.	flooding
		d.	weather
		e.	CWI
		f.	ionospheric event
		g.	hut heating or air conditioner failure

		h. unknown
5. PRIMARY POWER	A. Commercial	a. interruption external to station
		b. interruption on station
		c. Surges affecting load - tripping overloads, breakers, etc.
		d. reduced line voltage ("brown - out")
	B. Emergency	a. long delay in assuming generator load - automatic Generator
		b. long delay in assuming generator load manual
		c. prime mover failure
		d. generator failure
		e. distribution system failure
		f. surges
		g. mechanical support system failure
		h. control system failure - automatic switchover system
	C. Station Power	a. prime mover failure
		b. generator failure
		c. distributtion system
		d. surges
		e. mechanical support system failure
		f. control system automatic switch over system
		g. power conditioner

6. PERSONNEL	A. Military Watchstander	a. technical training or skills lacking
		b. operations training or skills lacking
	B. Military Technician	a. technical training or skills lackings
		b. operations training or skills lacking
	C. Civilian Watchstander	a. technical training or skills lacking
		b. operations training or skills lacking
	D. Civilian Technician	a. technical training or skills lacking
		b. operations training or skills lacking
	E. Military Engineer (visiting station)	a. installation - calculated risk
		b. blunder
	F. Civilian Engineer (visiting station)	a. Installation-calculated risk
		b. blunder
	G. Other Personnel	a. station personnel - accidental switch activation, etc.
		b. station visitor - accidental switch activation, etc. (e.g., visiting high school class or civilian dignitary)

NOTE: All Commandant, RM, CM, COCO, EECEN, etc. visitors or associated contractor personnel (other than operating personnel) will be considered under (E.) or (F.) above.

7. MISCELLANEOUS	A. Natural	a. lightning Phenomenon
		b. flood
		c. earthquake
		d. other (i.e., volcano eruption)
		e. antenna arcing (due to atmospheric conditions not tower failures)
	B. Catastrophe	a. tower failure
		b. building integrity failure leaky roof, window, etc.
		c. fire
		d. other
		e. antenna arcing (due to failure of the loading element insulators)
		f. antenna arcing (dueto failure of base insulator)
		g. antenna arcing (due to failure of any other insulator)
	C. Physical	a. scheduled tower maintenance Maintenance
		b. emergency tower maintenance
		c. prime power system rehabilitation or major maintenance schedule
		d. building maintenance scheduled
		e. other
	D. Political Situation	a. official
		b. unofficial-e.g., civil disturbance, riot

	E. Labor	a. strike, shutdown
		b. limited operations/ repair - USCF or host nation agency
supervisory/		administrative personnel staffing level
		c. limited operation/repair- work to rule.
8. REMOTE OPERATING SYSTEM (ROS)	A. ROSS	a. CAQI-9836 computer
		b. ROSS software
		c. printer
		d. VAU
		e. modem UDS RM-16DK
		f. Hayes Smartmodem
		g. buss expander
		h. UPS-501-1
		i. ROS data links
	B. LSOS	a. phase microstepper #1
		b. phase microstepper #2
		c. timing interval counter
		d. multi-programmer interface
		e. multi-programmer
		f. ROS interface
		g. printer
		h. CAQI-9826 computer
		i. LSOS software
		j. UPS-501-1 battery pack
		k. UPS-501-1-113
		l. modem UDS RM-16DK
		m. modem phone

2.E.3.h. Interference To Loran-C.

(1) Synchronous and Near Synchronous Interference. Synchronous interference will likely be manifested by a constant offset in the ECD or TD recordings. Near synchronous interference usually results in sine waving or other periodic patterns in the ECD or phase time difference strip charts. Sine waving will generally be long term and may or may not be accompanied by an offset.

(2) Asynchronous Interference. Asynchronous interference will cause erractic patterns to appear on the ECD or TD recordings. An increase in the noise level may also be apparent. Receiver acquisition and tracking may be impaired.

(3) Interference Message Format. A message will be sent to the RM, CM, COCOs, and affected stations whenever harmful interference to Loran-C is suspected. The proper format is shown below.

R

FM (Unit making report, normally the control station)

TO (REGIONAL MANAGER)

INFO (Chain Manager, appropriate COCOs and

affected stations in the baseline)

BT

UNCLAS //N16577//

SUBJ: REPORT TO INTERFERENCE TO LORAN

A. AIDS TO NAVIGATION, COMDTINST M16500.13

1. (Baseline(s) affected: e.g.: 9960M-W)

2. (Degree of interference: annoying, marginal

or disruptive and Chart peak-to-peak activity)

3. (Inclusive dates and (GMT) times of the interference)

4. (offending station data, report only if known)

A. (Call sign)

B. (Frequency)

C. (Location)

D. (Signal strength at the receiving site)

E. (Equipment used for measuring signal strength:

e.g.: CDFO-2000/HP-310, CDFO-500/HP-310)

F. (point of contact at offending station)

5. (Remarks or comments pertaining to the interference, request to install internal notch filters if you believe these will resolve the problem, etc.)

BT

2.E.3.h. (4) Chain or Regional Manager Responsibilities. The Chain or Regional Manager will attempt to locate the interfering source and resolve the issue. Loran station and control station personnel may be directed to put in multicoupler or CDFO-5000A internal notch filters to reduce the effects of the interference. These filters should not be put into the circuits until directed by COCO, the CM, or the RM and should only remain installed temporarily.

i. Interference From Loran-C..

(1) Stations Receiving Interference Reports. Loran-C emissions must be in accordance with the signal specification. That is 99 percent of the power must be in the 90 to 110 kHz band. Stations receiving reports of interference to other entities from Loran-C will forward the report to the RM and CM.

(2) Action by Chain Manager. After contacting the entity reporting the interference the CM will determine the offending station and take Loran Data Acquisition (LORDAC) set or pulse and spectrum measurements to verify the extent of the problem. The CM will coordinate resolution of the problem. The CM will keep the RM advised of the situation and forward a report with the allegation, the results of the spectrum and pulse analyses, and any other observations or measurements made in the service area. If the issue remains unresolved, recommendations should be incuded so that the RM can continue to resolve the issue.

j. Loran-C Tower Light Outage Reports. Domestic Coast Guard Loran-C stations must report outages of their tower warning lights to the Federal Aviation Administration (FAA) to satisfy Federal Communications Commission (FCC requirements. Tower light outages are a local problem and fall within the FAA's Notice to Airmen (NOTAM) criteria. The Flight Service Station (FSS) in a specific Loran-C station's area must be notified. Other Loran-C stations will report outages as required by local instructions.

2.E.3.j. (1) Action Required. COCOs and unit commanders shall ensure that tower light outages are reported. Telephone reports directly to the FSS are all that is required. The FAA will then issue the appropriate Notice To Airmen (NOTAM). When the tower light outage has been corrected, a follow-up report using the same procedure used for reporting the outage will be made so that the FAA can cancel the NOTAM. Timely reporting of the light back in service is as important to the NOTAM system as the initial report.

(2) Required Information. All reports should include the name of the person making the report, the telephone number, the name of the station affected, time the outage occurred or was repaired, and the estimated time of repair. The FSS telephone numbers to be used by each Loran-C station are promulgated by the COMDTINST 11133 series.

(3) Overseas stations will report outages to local government officials as directed by the RM.

4. Records.

a. General. Records include all logs, plots, data sheets, teleprinter rolls, maintenance logs, strip charts, 15-minute graphs (bias plots), radio logs, messages, ROS printouts, station drawings (blueprints), and Engineering notebooks generated during Loran-C operations. All records will be kept in English and wherever possible in blue-black ink.

b. Loran-C Station Logs. This log is for use by transmitting stations When properly maintained, the log will contain a record of all significant data pertaining to the system and signal performance measurements, and all adjustments or irregularities during a complete 24-hour day. The information required for the daily report to COCO shall be entered on the log. Instructions for completing the log are:

(1) Consecutivelyl number each log sheet during a Loran month. Start a new series of numbers (with number 1) at the beginning of each month. The Loran month begins on the first Tuesday of the month.

(2) The Loran day is normally from 0000Z to 2400Z but may be defined by COCO to coincide with system sample periods or other convenient times.

(3) Station: Enter station proper name (e.g., LORSTA Sellia Marina).

(4) Rate: Record the rate and function (e.g., 7930-W).

(5) Antenna: Stations having more than one installed receiving antenna shall indicate which antenna is in use.

2.E.4.b. (6) Oscillator Data: Oscillator serial numbers and daily phase comparison shall be indicated in the appropriate blocks.

(7) System Parameters: Stations shall record the values of the parameters (LEN, SYNC, TINO, ECD) under their function column.

(8) Time: All entries shall be made in GMT to the nearest minute.

(9) Log Entries: Stations shall only log those actions they perform or observe and shall not attempt to reconstruct and log events that occurred during unwatched operations. However, logging the repair of an equipment that failed while in unwatched mode is an appropriate entry. Significant occurrences during the day should be recorded, including but not limited to:

(a) Name of watchstanders at the beginning of the Loran-C day and when relieved, signature of the relieved watchstander.

(b) Beginning and end of abnormal conditions.

(c) Equipment changes.

(d) Adjustments (e.g., LPA, ETA, PGEN, Droop, RCVR, etc.).

(e) Failure or repair of equipment or red SAU alarms.

(f) Red SAU alarms.

(g) Time checks.

(h) Start and stop of blink times when in local control.

(i) Loss and restoration of communications.

(j) Changes of baseline and times.

(10) Unusable Time: Enter the number of minutes off air (from the RCI Off-Air counter), and the total UUT (in minutes) while in local control.

(11) Control: Enter number of minutes in Bravo or Delta control for each baseline.

(12) System Sample: Enter system sample information.

c. Station Logs and Watch Relief. The first important process of watch relief is the transfer of informtaion from the previous to the new watchstander. At a minimum, the following shall be entered in the log:

(1) The status of all Loran-C equipment, including primary power generation equipment (if applicable).

(2) The status of all communication links.

2.E.4.c.(3) Information concerning all pending actions; e.g., a time step is scheduled to occur on the next watch.

(4) Current control (A, B, C, D) assignment.

(5) The offgoing and oncoming watchstanders will review all monitored parameters, the status board, and any watchstander instructions left by senior personnel.

The second important process is to tranfer responsibility for the watch. This transfer will be documented in the station's Loran-C log. To ensure proper transfer, the log entries shall:

(1) Indicate the time of relief.

(2) Include the name and signature of the ongoing watchstander.

(3) Include the name and signature of the oncoming watchstander.

(4) Document any areas of disagreement between the two watchstanders. The oncoming watchstander will be responsible for this entry.

In general, logs must be sufficiently detailed to allow reconstruction of the events of the day. Of particular interest are the records of unusable time and casualty recovery. Figure 2-9 is provided as a station log example.

d. <u>Transmitting Station Log Keeping Requirements</u>.

(1) <u>Cesium Beam Frequency Standard Logbook</u>. A Cesium Beam Frequency Standard logbook is provided with each standard. These logs are the detailed history of the standard and remain with the standard. They are included with the standard when returned. Ocsillator meter readings will be entered in this log weekly.

(2) <u>A Loran-C Transmitter Log</u>. This log shall contain both a dated narrative summary of maintenance performed and the daily transmitter readings. This log is historical in nature and must be retained.

(3) <u>Frequency Standard Rack Work Log</u>. This log shall contain a dated narrative summary of any maintenance or cleaning, or any environmental changes to spare. This log is historical in nature and must be retained.

(4) <u>Daily Pulse Analysis Log</u>. All vacuum tube transmitting stations will maintain a pulse shape analysis log of half-cycle values. computed percent RMS error, and the ECD of pulses 1 and 7 for secondary stations (1 and 3 for master stations). Pulse shape will be taken using the most accurate means of measurement available (e.g., differential comparator). This log should be reviewed periodically to determine differences between transmitters and trends in computer ECD. Pulse analysis

LORAN-C STATION LOG

DATE	16 OCT 87
SHEET No. FOR THE MONTH	16

STATION	RATE	SUNRISE	SUNSET	ANTENNA
USCG LORSTA NANTUCKET, MA	5930-X	0607	1742	625 FT

OSCILLATOR DATA	OPERATE	STANDBY
SER. No.	1098	552
VS STANDBY PHASE DIFF.	+040/148	
VS OSC 3 PHASE DIFF.	-064/184	

SYSTEM PARAMETERS	MASTER	WHISKEY	XRAY	YANKEE	ZULU
	CONTROL/STANDARD TIME DELAY				
LEN/ENVELOPE/CSECD			1471.6		
SYNC/PHASE			11990.2		
TINO			10518.9		
ASSIGNED ECD			0.0		

TIME (U.T.C.)	LOG ENTRIES	W	X	Y	Z
0000Z	BGN GMT DAY, ET3 GADGET ON WATCH, TMR 1, PATCO 37, CN1 OPR, AN/FSN-3				
	CASREP				
0550Z	RED ALARM, HCG FAULT				
0600Z	HCG II3A2A2 IN MAINT				
0703Z	HCG II3A2A2 OUT OF MAINT				
1125Z	BGN W/S DRILLS				
1245Z	END W/S DRILLS				
1258Z	EPA IN MAINT FOR CALIBRATION				
1300Z	GROUND C/C				
1358Z	EPA OUT OF MAINT, ENABLE C/C				
1515Z	MOM O/A, AUTO CN SW, TAILBITER FAULT, CN2 OPR				
1532Z	MOM O/A, ROUTINE CN SW, CN1 OPR				
1705Z	ET3 GADGET RELIEVED BY ET2 TWIDGET				
	G A Gadget, ET3, USCG				
2022Z	MOM O/A, LIGHTNING STRIKE, AUTO CN SW, CN2 OPR				
2023Z	OOT, D-CNTL, START BLINK				
2026Z	EMER TMR SW, 1 TO 2, INTOL, STOP BLINK				
2045Z	ROUTINE TMR SW, 2 TO 1				
2048Z	A-REMOTE CNTL				
2400Z	END GMT DAY, ET2 TWIDGET ON WATCH, TMR 1, PATCO 37, CN2 OPR, AN/FSN-3				
	CASREP				
	T W Twidget, ET2, USCG				

PAIR	BK_M	BK_S	BTH	OT	OF	OFAU	UTM	CONTROL BRAVO	CONTROL DELTA	LPA No.	LPA SUM	SYSTEM SAMPLE C/M/S	PP	ECD/E	V_{OP}		VALID CMDS
M-W																	
M-X	00	02	02	02	02	00	00	02	02	25	00	00	8766	050	-0.02	64.3	08
M-Y																	
M-Z																	

EQUIPMENT & LOG CHECKED BY - (Signature of watch supervisor)	LOG CHECKED & APPROVED BY - (Signature of CO)
E L Circuit CWO E. L. CIRCUIT, CWO, USCG	S L Justis, LTJG S. L. JUSTIS, LTJG, USCG, CO

2.E.4. (4) (Cont'd) for SSX stations are not required daily, but must be measured and calculated weekly or more often if specified by the COCO.

e. Control Station Log Keeping Requirements. The requirements of section 2.E.4.b apply. In addition, control stations equipped with Calculator-Assisted Loran Controller (CALOC) are exempt from maintaining 15-minute average graphs (001 forms). Since they will be used upon failure of the CALOC system, the watchstander must be familiar with using the form for determining LPA insertions.

f. COCO Log-Keeping Requirements. The COCO will maintain year-by-day plots for the following:

(1) Synchronization (using a scale of 100ns/cm).

(a) Alpha-1 of all baselines monitored.

(b) Alpha-2 of all baselines monitored.

(2) Envelope.

(a) Alpha-1, transmitting station EPA ECD (using a scale of 1 s/cm).

(b) The rms percent pulse shape error when applicable.

(c) Vp and Ic for operate tube-type transmitters.

(d) The transmitter number or coupler network number that is on air.

g. Strip Chart Recorder Requirements and Markings.

(1) Monitored Parameters. Permanent records of some of the parameters discussed in the monitored parameters section of operations are necessary. Each transmitting station will have chart recorders to monitor:

(a) EPA ECD. (Dual-rated stations cannot monitor both rates concurrently).

(b) Cycle compensation.

(c) TINO (for each baseline monitored).

(d) Amplitude (for each baseline monitored).

(2) Operation and Installation Requirements. Operation and installation of the chart records will meet the following requirements:

2.E.4.g.(2) (a) Recorders will be installed so that a positive increase in the monitored parameter will cause a pen motion to the right.

(b) At the beginning of the system sample period, adjust the recorder paper (if necessary) so pre-printed times correspond to actual GMT.

(c) Chart speed will be maintained as closely as possible to conform to the time graduations on the recorder chart roll.

(d) The control station will maintain a chart recorder record for each baseline controlled. Disposition of the record will be determined by the CM.

(e) Recorders shall be aligned with CSTD or CSECD at exact center scale so that deviation may be read directly from the chart.

(3) Minimum Chart Markings. The following markings are requireed as a minimum:

(a) At the beginning and end of each recorder chart annotate:

1. Inclusive dates covered by the chart with the start date at the beginning, and the end date at the end of the chart.

2. Name of station.

3. Date recorded, applicable station parameter (e.g., 9960-X TD, TINO, ECD, CYCLE COMP, or AMPLITUDE).

(b) At the beginning of each GMT day, or Loran log-keeping day, if different, annotate:

1. Date.

2. Name of station.

3. Data recorded (e.g., TD, TINO or ECD as applicable represented by center of the chart scale).

(c) Other markings:

1. Record changes in equipment status (e.g., change in TMCN, AVG, etc.).

2. Indicate equipment tests and adjustment on any strip chart that might be affected by the adjustment (e.g., receiver calibration).

3. Clearly indicate when recorded data might not be valid, and the reason why the data may be invalid (e.g., interfering frequencies, local weather, etc.).

2.E.4.g.(3) (c) 4. Recorder calibration checks.

5. Record LPAs or MPAs entered and any change in assigned ECD.

6. Any unusual variation will be marked on a "watched" station chart.

h. Engineering Notebooks.

(1) General. In the past, it has been difficult to determine what engineering, installation, or certification work (and associated results) have been completed at a particular Loran-C station. Documentation varies from station to station. Historically, no station has sufficient engineering documentation on board to allow engineers or inspectors to accurately assess and compare their results.

(2) Requirements and Purpose. Each RM will publish guidelines for maintaining engineering notebooks. An identical copy will be maintained at the CM's office. These notebooks will provide a chronological reference of all engineering work accomplished at a particular station and the associated results. This includes inspection or visit reports, signal specification compliance measurements, certification results, any special project results, and any non-standard features of the station or site.

(3) Information To Be Entered. Information that should be included in the notebooks:

(a) Trip or Inspection reports.

(b) Certification reports.

(c) Frequency Scan results.

(d) Engineering notes:

1. TCE.

2. CALOC.

3. CDFO-5000A.

4. Transmitter.

5. ROS.

(e) LORDAC test results for transmitters.

(f) Any other material deemed relevant by the RM.

Table 2-4 Record Retention

(a)	PCMS teleprinter rolls (at monitor site)	30 days
(b)	Control and Admin teleprinter rolls	1 year
(c)	PCMS teleprinter rolls (at control station)	1 year
(d)	Alpha charts (A1 and A2)	1 year
(e)	Phase recorder chart rolls	1 year
(f)	ROS logs and plots	3 years
(g)	Station logs	3 years
(h)	CALOC plots	3 years
(i)	Abnormality analysis:	
	significant interest (full report)	Permanent*
	not significant (messages)	3 years
(j)	COCO monthly report:	
	COCO	Permanent*
	Station	3 years
(k)	Operations Data Request if used for litigation	10 years
(l)	Unit award/recognition	Permanent*
(m)	COCO plots of oscillator offsets	Permanent*
(n)	COCO plots of Loran station signal parameters	Permanent*
(o)	Amplitude vs Frequency plots (for notch filters)	Permanent*
(p)	Engineering notebook	Permanent*

*Permanent is 5 years after the station is closed.

2.E.4.i. Record Retention Requirements.

(1) General. The records, logs, charts, and teleprinter rolls held by the various Loran entities will be retained according to the Paperwork Management Manual (COMDTINST M5212.12) as outlined in Table 2-4 below. When any doubt exists as to retaining the material, consult the Regional Manager before disposition. All Loran-C records are considered the property of the Regional Manager.

(2) Historical Documents. In all cases, any document recording events of historical significance will be retained as long as a station exists. Disposition instructions will be given for these documents in the Operational Order for decomissioning.

5. Authorized Unusable Time (AUTM) and Emergency Unusable Time (EUTM).

a. Discussion. Together, AUTM and EUTM cause more loss of serviceto the users than any other factor. Due to its nature, EUTM is difficult to control. However, by close supervision and control, AUTM can be kept to the minimum necessary to accomplish needed maintenance and projects. Approving authorities must balance the stations occasional need for AUTM against the loss of service to the user. When the issue is evenly balanced, service to the user must take priority.

b. Definitions.

(1) EUTM - Unusable Time (UUT) necessary for urgent equipment or tower maintenance. Failure to perform this maintenance will jeopardize the station's operational mission. Sufficient time is available to request the UUT, but not enough to solicit objections.

(2) AUTM - The UUT necessary for projects or routine equipment or tower maintenance. Failure to perform this maintenance will not immediately jeopardize the station's operational mission; however, the mission will eventually be in jeopardy if not accomplished. Sufficient time is available to solicit objections. If significant objections are received, UUT can be canceled or rescheduled. Scheduling should be based on known user requirements and when necessary scheduled for nights or weekends. The responsibility for accessing these needs resides with the RM.

c. Responsibilities.

(1) Approving authority. All requests for AUTM or EUTM will be critically examined to ensure that the UUT is necessary, and the time requested is reasonable.

(2) Submission. Requests for AUTM will be submitted 30 days prior to the desired date by the requesting entity with all the information necessary to advertise to the users. Additional information which may be helpful includes point of contact (with

2.E.5.c. (2) (Cont'd) phone numbers) for district or contractor work and the purpose of the off-air.

(3) Categories. Requests for off-air fall into several different categories depending on the operational relationship involved and the amount of time requested.

(a) Less Than Two Hours. These requests will be processed by COCO.

(b) More Than Two Hours. These requests will be processed by the CM.

(c) Dual Rate LORSTAs.

1. When the rates are controlled by the same COCO and the requested off-air is for two hours or less, the request will be sent to COCO for action.

2. When the rates are controlled by different COCOs, the requests will be sent to the CM for action.

3. When the rates have different CMs but the same RM, requests will be sent to the RM for action.

4. Special cases where different RMs are involved will be addressed by the RM's Supplemental Instructions.

d. Request Process. An AUTM request will generally follow the flow chart, figure 2-10. Details concerning each section in the flow chart are provided in the following paragraph. No flow chart can cover all possible situations. Approving authorities and requestors may modify the process as needed. Remember the purpose is to keep AUTM to a minimum, not to create an administrative problem.

e. Flow Chart Explanation. Each section of the flow chart is discussed below. Explanations will define what is expected from both the requestor and the approving authority.

(1) Block 1. The requestor has reviewed the circumstances and has decided the AUTM is necessary. The off-air request will be made either by message or letter to the approving authority. The requestor will ensure all other concerned entities are informed, either by copy or as information addressees. As a minimum, all situations in the affected chain(s) shall be informed.

(2) Block 2. The approving authority reviews the request to ensure the following information is included:

(a) A list of all tasks planned for the AUTM period. Required information concerning each task is:

1. An estimate of the time required to perform the task. If two tasks are to be performed concurrently, so indicate.

2.E.5.e.(2)(a) 2. Why the task is necessary. State the impact on operations if the task is not completed.

(b) A statement of when the AUTM period is desired and an alternate date. Inclusive times and alternatives will bein DTG format; e.g., 091000-091200Z APR 86; alternate is 12100 0-121200Z APR 86.

(c) The name, location, and telephone number of the requestor's point of contact. This will be the individual able to answer questions concerning the AUTM justification.

(3) Block 3. Approving authority and requestor have to continue efforts to obtain a property formatted request.

(4) Block 4. Approving authority checks request's receipt date. Receipt should be at least 30 days prior to the AUTM period.

(5) Block 5. The approving authority reviews the request to ascertain if it meets the following requirements:

(a) Justification is Sufficient. Using both the information provided by the requestor and own information and knowledge, determine the impact if the AUTM is not granted.

(b) Requested Task Times are Reasonable. Determine if task times are reasonable.

(c) No Existing Conflicts. Ensure the requested AUTM doesn't conflict with a previously scheduled event; e.g. other AUTM periods, operational requirements, inspections, etc. An AUTM for different stations in the same chain can run concurrently; however, be careful of the impact on the user. Concurrent AUTM may make it worse. Unless specifically requested, AUTM should not be scheduled during an inspection. For other operational requirements, the need for the AUTM shall be balanced against the requirement. If the AUTM wins, grant it.

(d) No Other Reasons Exist for Not Granting AUTM. Self-explanatory.

(6) Block 6. The approving authority must determine if there is sufficient time to solicit objections and receive responses. The decision process in this block must also take the reason for the AUTM into account. If the reason for the AUTM is urgent (e.g., needed transmitter repairs or contractor work which can't be re-scheduled), then the minimum times will be used. Minimum times are:

(a) AUTM request received at least ten days prior to AUTM.

(b) Solicitations of objections deadline to be at least three days prior to AUTM.

2.E.5.e. (7) Block 7. Approving authority denies request for AUTM. The requestor and all cognizant entities are informed by message. The message will contain the following:

(a) The reason(s) why the request was denied. Simply stating "insufficient advance notice" is unacceptable. Provide specifics regarding need fro solicitation of objections and notices to users.

(b) A request for a new date and time for the AUTM.

(8) Block 8. Approving authority provisionally grants the AUTM pending responses from a solicitation of objections. Full approval will not be granted until the responses have been received and reviewed. A "Solicitation of Objections" message is sent immediately following or concurrent with the message advising the requestor (and all interested entities) of the provisional AUTM approval. Depending on the amount of advance notice, the response deadline for the users shall be sent between 3 and 10 days prior to the requested AUTM. Get as much notice as possible.

(9) Block 9. The approving authority will make every effort to resolve any differences with the requestor. An AUTM will not be granted until the approving authority is satisfied.

(10) Block 10. Self-explanatory.

(11) Block 11. Self-explanatory.

(12) Block 12. The approving authority must review all objections received and balance them against the justification of the AUTM. Direct liaison with the objector is authorized for this purpose. The requestor must be informed that an objection(s) has been received and is under review.

(13) Block 13. Approving authority sends a notice to users stating the AUTM has been canceled. Indicate in general terms (e.g., "due to significant user objection") why the cancellation took place.

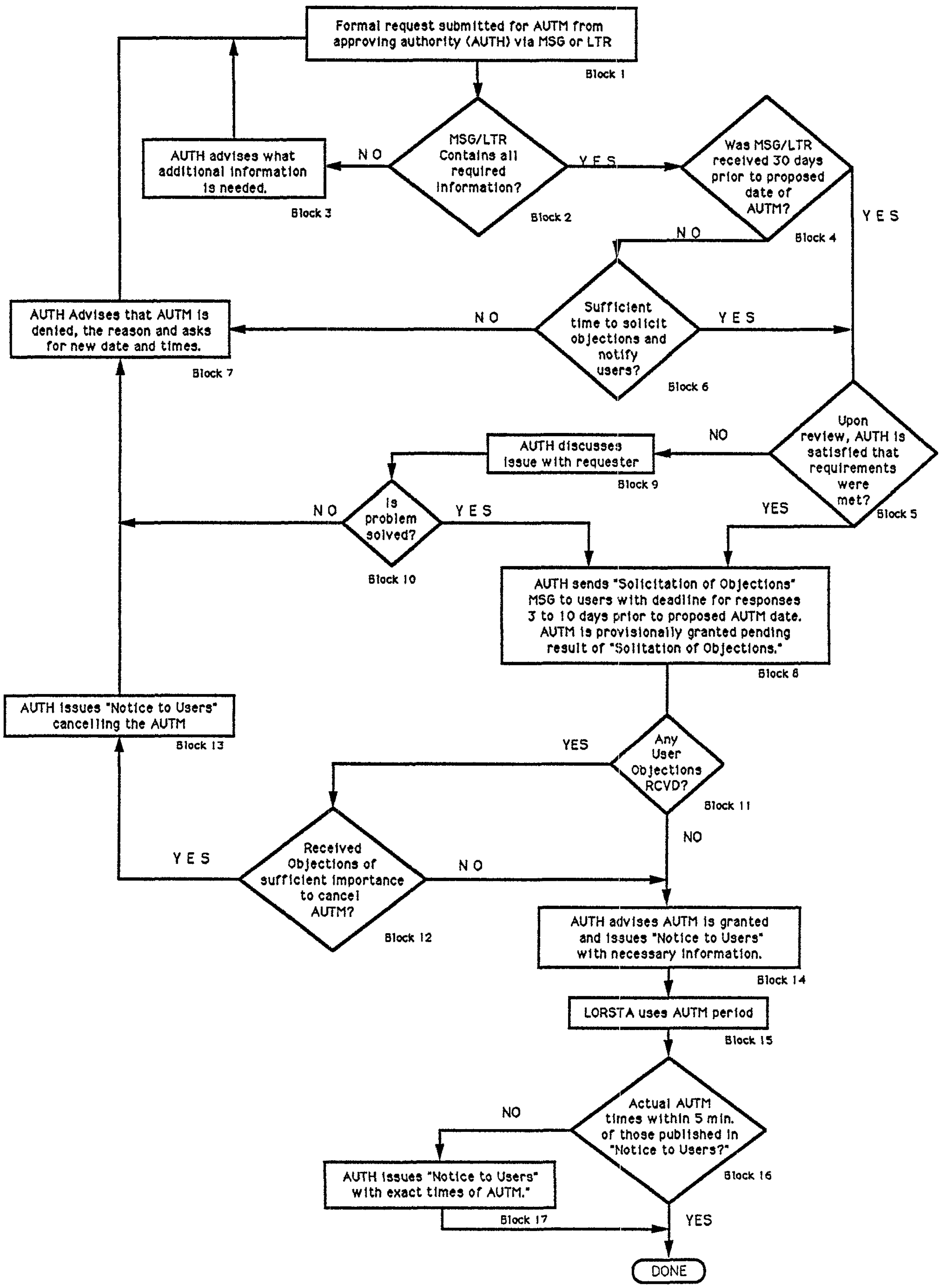
(14) Block 14. The approving authority grants final approval for the AUTM and issues a "Notice to Users" message containing the following information:

(a) The inclusive date and times of the AUTM period.

(b) The alternate date.

(c) A brief explanation of why the AUTM is necessary. DO NOT use technical jargon or "buzzwords."

(d) Instructions for handling by the FAA's National Flight Data Center (NFDC).



AUTM Request Flowchart.

2.E.5.e. (15) Block 15. Self-Explanatory.

(16) Block 16. The approving authority must review the actual times used by the LORSTA to determine if the actual times were within plus or minus five minutes of those previously published.

(17) Block 17. The approving authority will issue a final Notice to Users advising the exact times of the AUTM period.

6. Special Requests.

a. Introduction. From time to time LORSTAs will receive requests to obtain operational data or conduct field tests. Requests may come from non-Coast Guard entities, both government and commercial, or from Coast Guard commands. Such requests generally fall into three categories: one-time; continuing for a brief time span; or continuing for a long time span. For the requestors that are not familiar with the Loran-C chain of command, this section is intended to provide guidance in how to submit a request.

b. Purpose. Specific procedures concerning special requests are being provided to protect Coast Guard units, COCOs, and staff elements from unnecessary demands on their resources. Any extra effort required to record, collate, and forward operational data or conduct field tests must be derived from already existing resources. Such a demand may or may not be feasible dependent on the urgency of the moment. Some considerations in this protection are:

(1) To stop "fishing expeditions," collecting data or conducting tests may be requested with no clear idea of either what the results might be or how the results may be used. If the requestor doesn't know what is being sought, then it's not worth our time to provide the service.

(2) To ensure that provision of data or field tests do not continue beyond the period desired by the requestor. Occassionally, a requestor will fail to advise use when data or testing is no longer needed. If this happens, we're wasting time and resources.

(3) Ensure data is easily accessible in the format desired by the requestor. If it's not, the additional workload to put the data in the desired format must be considered against the benefits received.

(4) To preclude testing or provision of data without the knowledge or consent of the Regional and Chain Managers. Operational data is essentially their "property" and providing it to anyone without their knowledge is not authorized. The RM, CM, and COCO must be aware of any testing which may put Loran-C operations "at risk."

2.E.6.c. Definitions.

(1) Operational Data. Almost anything relating to Loran-C operations can be defined as "operational data." However, for the purposes of this section, operational data are defined as data which:

(a) Require a change in normal procedures in order to provide such data, or

(b) Will be a significant demand upon available resources.

(2) Field Test. The testing of equipment, software, or procedures under actual operating conditions.

d. Procedures For Handling Requests.

(1) Sample Data Requests. Except in the most unusual circumstances, all requests will be in writing. If a request is received by a station, the CO or OIC will either forward the request to COCO or ask the sender to forward the request to COCO as appropriate. The COCO may then forward the request, with a recommendation, to the RM via the CM. The COCO may respond to simple, easily met requests for data as they occur. An example of such a request would be for information which is on the chain data sheet or coverage diagram. These requests will be summarized in the COCO monthly report of operations.

(2) Operational Data Requests. Requests made to COCO for operational data or field tests (including extension of an already approved test period) will be forwarded to the appropriate RM via the CM. The written request from the requestor will be screened. When the RM has verified that the material should be released, the RM will have the information provided. Some requests have been for "continuing" reports or information. The requested data may not be available in the desired format or for the duration desired. In some cases the request may be for some action, the RM will evaluate the risk before granting the action. In other cases, information can be provided by the COCO, CM, or RM. Generally, the contol station will be tasked to provide an affidavit concerning the operational performance of a particular Loran-C signal or baseline. Data will not be provided until specifically authorized by the RM.

(3) Minimum Information for Requests. The minimum information necessary to process a request includes:

(a) Name, address, and telephone number of requestor (including a point of contact if available)?

(b) What data or testing are desired?

(c) If data, in what format (e.g., copies of reports, magnetic media, etc.) is the data desired? If testing, what reports are necessary and in what format?

2.E.6.d.(3) (d) If data, how will the data be used? If testing, what is being tested and why?

(e) When is the data or testing required and for how long?

(f) What is the impact if the data or testing is not provided or allowed?

(4) Request for Uninterrupted Operational Periods. From time to time, an organization will request that operations be carried out with no unnecessary interruptions to the Loran-C signals. Generally, the stations from which the signals originate will not be allowed to perform any planned maintenance, transmitter shifts, or any other equipment change or adjustment which will affect the on-air signal during the requested period. If operations are adversely affected at anytime during the period, the action requested will be immediately suspended, corrective action and blink begun if necessary, and the COCO, CM, or RM notified. The requestor will be contacted and advised of the difficulty in complying with their request. Alternate actions or times may be scheduled.

e. Action During Evaluation Of Request.

(1) COCO or LORSTAs.

(a) Notify next higher echelon of all requests for operational data or field testing.

(b) Do not provide or allow any data or testing until specifically authorized by the Chain Manager.

(2) RM or CM.

(a) Evaluates the request. Considerations are:

1. Benefit, long- or short-term, which may accrue to the USCG either in general or specifically related to Loran-C operations.

2. Costs, both in human resources hours and dollars, to provide the data.

3. Any possible impact on operations.

4. How the data will be used.

5. Period for which the data is desired.

(b) Within 10 working days after receipt of the request, advise all concerned if data will be provided. Response will be by message and will contain:

2.E.6.e.(2)(b) 1. If request is approved, notification of approval plus a statement requiring RM evaluation and approval for any extension of the period in question.

2. If request is disapproved, notification of the disapproval and the reason for the disapproval. Advise the requestor of where the decision can be appealed, (e.g. COMDT (G-NRN)).

(c) While complying with the request:

1. Stations. Provide the requested information or perform the test for the period authorized. If maintenance or operations are adversely affected at any time during this period, advise COCO immediately.

2. COCO. If data or testing are available only from COCO, requirements for COCO are the same as for stations. If data or testing are provided or performed by a station, COCO, will be responsible for ensuring both continuing normal operations and correct reporting of the program. The COCO always has the authority to secure the program if operations are adversely affected.

3. RM or CM. Monitor all such programs to ensure data or testing is started and terminated at the agreed times.

f. Requests For Data For Litigious Purpose.

(1) Purpose. From time-to-time, the Coast Guard is required to provide definitive statements regarding Loran-C signal stability and usability for use in litigation.

(2) Format. Figure 2-11 is a sample affidavit format.

(3) Expert Witnesses. All requests for expert witnesses will be referred to the Regional Manager. As outlined in 49 CFR Part 9, the Coast Guard does not provide expert witnesses except in very rare instances.

7. Control, Communications, and Monitor Plan (CCMP).

a. Introduction. The primary purpose of the CCMP is to provide an overview of all important operational, technical, and support aspects of a specific Loran-C chain. It is a multi-purpose, non-directive plan primarily intended as a reference document for people involved with the operation and administration of the chain. The RMs shall develop a CCM for each chain under their control and send a copy of each to the Program Manager.

b. CCMP Outline. The following guidelines are provided as a suggested CCMP outline and should not be considered all inclusive. The final format shall be determined by the RM.

AFFIDAVIT FORMAT

In the Matter of)
______________________________)
______________________________)
______________________________)

____
(DATE)

AFFIDAVIT

Comes now ___________________ (Name of Affiant) and after duly sworn states as follows:

That he is a _____________ (Rank) in the United States Coast Guard and is presently assigned to duty as _____________________________________ (Duty Assignment).

That he has personally examined the logs and recorder charts pertaining to Loran-C Rate(s) ___________________________________ for the period ___________________ to ___________________, all of which are official records of the United States.

THAT the recorder strip charts examined provide continuous Loran-C data from the following independent sources:

1.____

2.____

THAT based upon his examination of said records, all Loran-C signals on all baselines covered by those records were transmitted at the assigned output power levels, with a correct pulse shape and with correct timing throughout the period noted, except as follows:

DATE	LORSTA	OCCURRENCE	TIME START	TIME SET	TOTAL TIME
____	______	_________	______	______	______
____	______	_________	______	______	______

FURTHER THE AFFIANT SAYETH NOT.

____
(AFFIANT)

SUBSCRIBED AND SWORN TO BEFORE ME THIS _____ DAY __________ 19 ___.

____
SAMUEL J. SMITH
Lieutenant, U.S. Coast Guard
Pursuant to 10 U.S.C. 936

copy: Regional Manager

2.E.7.b. (1) Purpose. The first paragraph is a brief statement describing the purpose of the plan.

(2) General. This section provides information applicable to all aspects of the Loran-C chain. This information should include:

(a) System Description. Describe the geographic coverage area, identify stations, GRI, etc., to provide a basic chain overview.

(b) CCMP Updating Responsibilities. The CCMP shall be updated annually or whenever major changes occur to the chain. The CM and COCOs should review the CCMP and forward recommendations and corrections to the RM.

(c) Chain Command Organization. A description or diagram of the chain of command for the chain should be included.

(d) Chain Operations. This is a brief listing of instructions, directives, and doctrines used for guidance.

(e) Chain Support. Support responsibilities of Area and District offices, and COCOs are outlined. Such things as inspections, training requests, etc., should be included.

(f) Engineering Support. This section includes the Systems Management and Engineering Facilities (SMEF), Electronic Engineering Center (EECEN), Electronic Engineering Laboratory (EELAB), and Commandant (G-TES) responsibilities.

(g) Maintenance. Maintenance philosophies, including contract maintenance, are summarized in this section.

(h) Spares and Logistics. Supply and repair depots for the various equipments should be listed in addition to any special logistic problems or procedures.

(i) Personnel Training. Formal and unit training requirements are outlined in this section. Course description, location, duration, and attendants should be listed.

(3) Control Plan. This part of the CCMP summarizes the majorfactors involved in the control of the chain.

(a) Chain Control Assignments. All control and transmitting station assignments, monitor sites, control mode priorities, etc., will be identified.

(b) Control Communications Priorities. Define the priority of the various control communications modes (i.e., teletype, telephone, master-ninth pulse blink, etc.) in this section.

2.E.7.b.(3) (c) CSTD and CSECD. Outline promulgation and amendment procedures for these parameters.

(d) Coding and Emission Delays. Coding and Emission Delays are listed for each station.

(f) Control Equipment. List the type, function, and location of all control equipment.

(4) Communications Plan. This part of the CCMP summarizes the major factors involved in chain communications.

(a) Control Communications. Primary communication circuits (TTY), descriptions, circuit designations, etc., should be described in this section.

(b) Telephones. Outline telephone procedures and list the numbers to be used for chain operations.

(c) Ninth-Pulse Blink. The policy for master ninth-pulse blink is stated in this section.

(d) PCMS Communications. Identify and describe the circuits, including circuit designations, used for PCMS links.

(e) Administrative Communications. Briefly describe the methods to be used for normal administrative communications.

(f) Contingency Communications. Briefly describe the contingency communications plan including testing of the circuits.

(g) Communications Equipment. List the type, function, and location of all communications equipment.

(h) Maintenance of Communications Services. Identify the companies or agencies responsible for the upkeep and repair of the communication circuits.

(5) Monitor Plan. This is an overview of the monitor configuration for the chain.

(a) Monitoring Assignments. All monitor sites should be listed with the parameters that are monitored.

(b) PCMS Equipment. List the type, function, and location of all monitor equipment.

(c) PCMS Maintenance Facilities. Identify the units or agencies responsible for the monitor sites.

(6) Appendices. Coverage diagrams, TTY and landline circuit diagrams, organizational diagrams, etc. may be included as appendices to the CCMP.

Chapter 3. Omega System Concept of Operations

A. Introduction to the Omega Navigation System.

1. Purpose. This chapter provides a brief description, history, concept of operations and the international relationships of the Omega Navigation System.

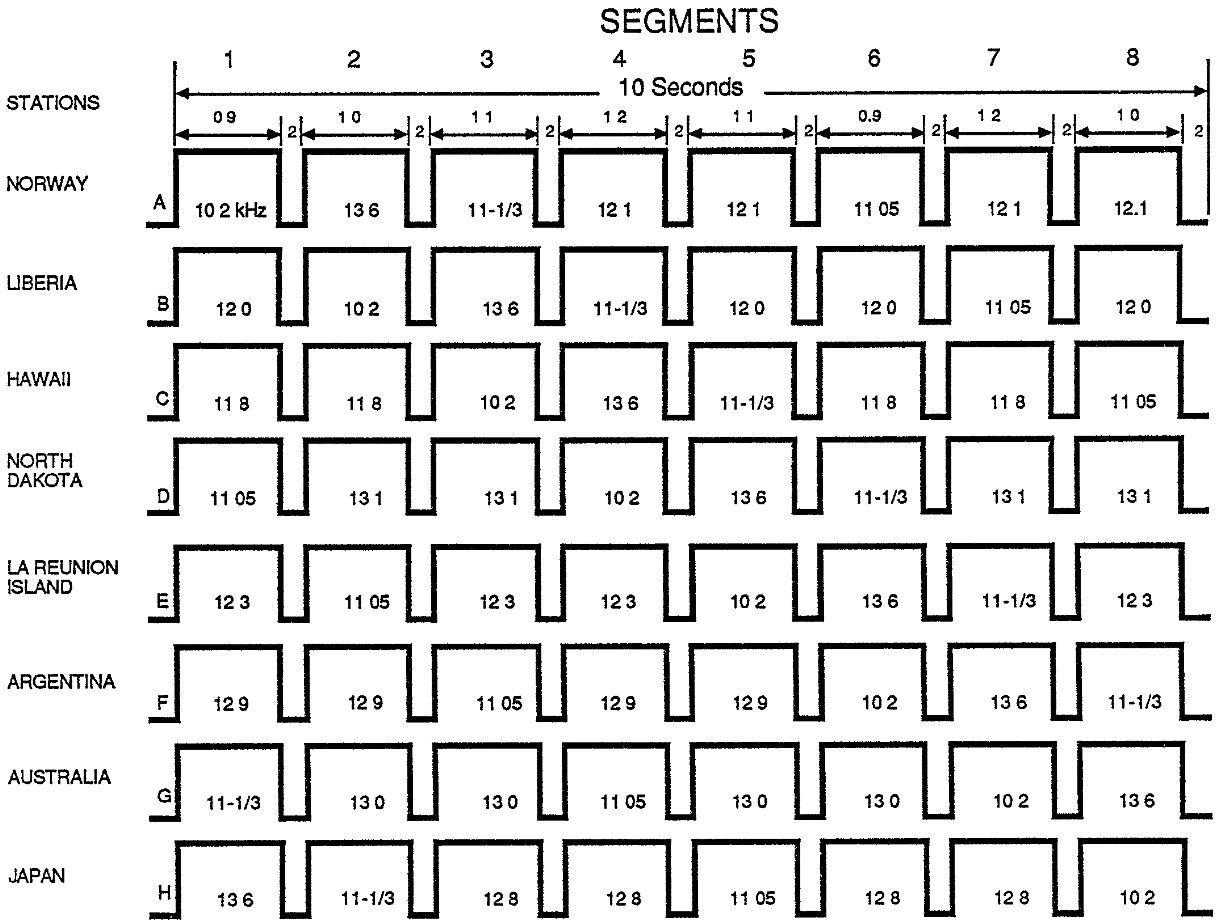
2. Description of the Omega System.

   a. The Omega Navigation system is one of several radionavigation systems, including Loran-C and Decca that use the principle of hyperbolic radionavigation. Unlike Loran-C, however, it employs the relative phase to phase difference of continuous wave (CW) signals transmitted at very low frequency (VLF) to achieve long-range navigation accuracy instead of relative time differences between transmitted pulses. The Omega stations transmit in the 10-14 kHz band. They are located in Norway, Liberia, Hawaii, North Dakota, La Reunion Island (France), Argentina, Australia, and Japan, and provide 24 hour, year-round worldwide signal coverage. In addition to the transmitting stations, there are approximately 50 monitor receiver sites located throughout the world to collect transmitted Omega signal data.

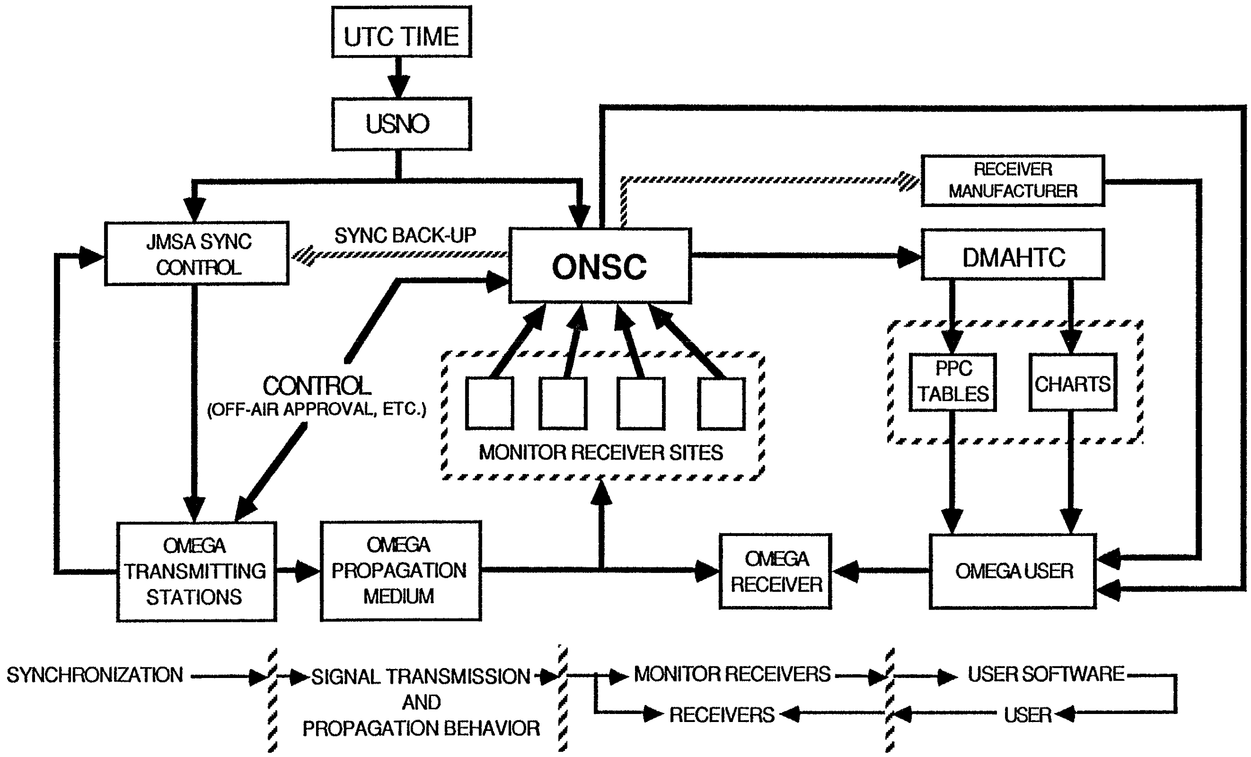
   b. The eight transmitting stations are synchronized by very accurate cesium frequency standards to ensure that each station transmits on the correct frequency and at the proper time. The signal format is depicted in Figure 3-1. The Omega transmitting system time (Omega Standard time) is in turn referenced to Coordinated Universal Time (UTC). Omega Standard Time, however, deviates from UTC by the number of leap seconds inserted in UTC since Omega Standard Time commenced on 1 January 1972 at 0000Z. Monitor receivers located at each transmitter site are used to compare the phase of other Omega stations' signals with the local station's signal.

   c. The individual monitor receiver sites, located throughout the world, sample transmitting stations' signals at fixed time intervals. These samples are used to determine the effect of the propagation medium on the transmitted signals and thereby improve the accuracy of published propagation corrections. This is discussed in greater detail in section 3-C-2-a. The block diagram in Figure 3-2 illustrates the basic functional relationships of the Omega system.

   d. The Omega system was designed to provide a minimum of three station availability worldwide and 2-4 Nautical Mile (NM) accuracy, 2 drms (distance root mean square). This translates roughly into a probability of 95% of being within 4 NM of the true position. Validation of the Omega system's performance, coverage, and accuracy is being conducted on a region-by-region basis. Two validation areas (North Atlantic and North Pacific) were declared operational in January 1983. The South Atlantic was declared operational in January 1984. Validation of the Indian Ocean was



Omega Signal Format



Omega System Functional Relationships.

3.A.2.d. (Cont'd) completed in February 1987. Data reduction, analysis and interpretation for the South and Western Pacific (re-validation) are currently being conducted. The airborne phase of the Mediterranean Sea validation is scheduled for OCT-DEC 1987. Final documentation for all regions is currently projected for FY 1990.

3. History.

a. The development of the phase difference hyperbolic radionavigation technique, which is basic to the Omega Navigation System, can be traced back to just after World War II. In 1947, J.A. Pierce first proposed a hyperbolic navigation system based on phase difference measurements rather than the pulse time difference techniques developed during World War II. Pierce suggested a system operating in the low frequency (LF) range of 50 kHz with 200 Hz sine wave modulation. An experimental system of this type was constructed by the Naval Electronics Laboratory and assigned the name RADUX. In 1955, efforts were successful in combining the LF signals of RADUX with separate VLF transmissions in the vicinity of 10 kHz. This system was called RADUX-Omega, and the initial transmissions of 10.2 kHz were made later that year. Subsequent experimentation led to the discontinuance of the LF transmissions. More concentrated research toward extending system range using the single frequency Omega system followed. Experimental stations were established in San Diego and Hawaii. A third experimental station began transmitting in 1959 from Forestport, New York. In subsequent years, Omega was expanded to a two-frequency format (10.2 kHz and 13.6 kHz). Additional Omega signals were broadcast from experimental stations in the Canal Zone and Wales and finally in Norway and Trinidad.

b. The need for a worldwide, continuous, user passive radionavigation system began to emerge as early as 1962. By 1966, the Omega signals were transmitted on a regular basis from four stations using existing facilities an R&D equipment; however, many inherent restrictions prohibited efficient operation. None of these stations were capable of transmitting the necessary power required for system efficiency; nevertheless, signals were transmitted continuously from a four-station Omega complex providing the vital ingredients necessary for further developmental research.

c. Until 1978, the Omega Project Office (PME-119) of the U. S. Naval Electronic System Command (NAVELEX) had overall responsibility to implement the permanent Omega system. The Navy negotiated with partner nations for transmitting station site selection, contracted station construction, prepared the bilateral operating agreements, contracted for the design and fabrication of electronic equipment and, together with the Coast Guard, established the initial system operations, maintenance, and support arrangements. Each partner nation's contribution to the Omega system varied with its interests and resources. The goal was to seek maximum partner nation participation including funding for station operation and maintenance.

3.A.3.d. During the early stages of system implementation, the Navy stated a desire that the Coast Guard eventually assume the full U. S. responsibility for the Omega system. In 1970, the Department of Transportation and the Department of the Navy reached an agreement on the Coast Guard's role. Coast Guard personnel, provided on a cost reimbursable basis to the Navy, were assigned responsibility for a significant portion of the implementation and operation of the system. Coast Guard personnel reported to the Navy Omega Project Office(PME-119), while remaining under the administrative control of the Commandant. On 17 October 1977 the Japanese Maritime Safety Agency (JMSA) assumed responsibility for system synchronization control. On 3 July 1978, the Coast Guard assumed the U. S. operational, maintenance, and navigation science responsibilities for the Omega system, although the Navy retained funding responsibility through FY80. At the beginning of FY81, the Coast Guard assumed full U. S.system management responsibility. These responsibilities for the Omega radionavigation system have been incorporated into the Coast Guard's Radionavigation Aids (RA) Program. As a program element, the
system is managed as is any other Coast Guard marine radionavigation system.

4. The Omega Navigation System Center (ONSC). The Omega Navigation System Operations Detail (ONSOD), a Coast Guard Headquarters Unit, was to Kailua Hawaii and then relocated to Washington in September 1974. In June 1986, the unit was relocated as a tenant command at Coast Guard Station Alexandria and renamed the Omega Navigation System Center (ONSC). The mission of ONSC is to direct the operation of each Omega station in such a manner as to ensure the Omega system, as established, provides usable, dependable radionavigation information conforming to prescribed system standards. The ONSC operates the Omega system subject to policies and procedures set forth by the Commandant, and consistent with United States obligations for Omega system operation under current bilateral agreements. To perform its mission, ONSC has divided its responsibilities into two broad areas: Operations-User Support and Engineering. Operations refers to those activities which involve direct control of the transmitting stations, dissemination of navigational warning notices (including station outages and propagation anomalies), and back-up control and computation for system synchronization. User support involves developing techniques and procedures which permit more accurate and effective utilization of the system. These techniques and procedures encompass primarily: propagation corrections (PPCs) for signals at all common navigational frequencies in computer algorithm format; signal coverage diagrams that show areas of signal availability under various reception criteria; and validation reports that provide extensive information on Omega signal behavior in each oceanic region. Many of these techniques and procedures are supported by the Omega Monitor network - a system of approximately 50 ground monitors measuring characteristics of Omega signals around the world. Engineering responsibilities encompass maintenance and support of all station electronics equipment including antennae, antenna support structures, and ground planes. The engineering staff also directs the implementation of station equipment modifications and is responsible for deployment, installation, and repair of Omega monitor sites

3.A.5. Partner Nation Operating Agencies. The organizational structure of the Omega Navigation System is set forth in specific provisions in each of the bilateral agreements between the U. S. and the partner nations in whose territory an Omega transmitting station is located. These agreements specify varying levels of participation within the Omega management structure in such areas as command, operations, logistics and engineering support. The Commandant, in tasking various Coast Guard elements with Omega responsibilities, has provided the guidance necessary to accommodate these variations. Responsibility between the U. S. and each partner nation is determined by the agreements and supplemental technical agreements between the Coast Guard and the partner nation. The Omega monitor facilities and their operation are established and carried out through country-to-country agreements, as required. In particular, the U. S. State Department has granted the Omega Navigation System Center Circular 175 authority to negotiate monitor agreements with a foreign agency.

6. International Omega Technical Commission (IOTC). During the 1976 Annual Omega Technical Conference, discussions were initiated which led to the signing in December 1981 of the Principles for Coordination of Operation of the Omega Radionavigation System by an International Omega Technical Commission. These principles, signed by each of the seven Omega partner nations, established the IOTC and provided broad guidelines for its function and conduct.

a. The broad objectives of the Commission are:

(1) To achieve effective harmonization among Operating Agencies, Omega users, equipment manufacturers, international and scientific organizations and associations.

(2) To promote the continued operation and improvement of Omega for the safe and expeditious movement of vessels and aircraft.

b. The Commission should:

(1) Promote the international coordination of Omega matters;

(2) Facilitate the exchange of technical information between and among the Operating Agencies as well as Omega users;

(3) Foster public understanding and user education by providing information through national and international forums;

(4) Consider comments from users and other interested parties;

(5) Make recommendations regarding the operation and administration of Omega.

3.B. Command and Control of Omega Operations

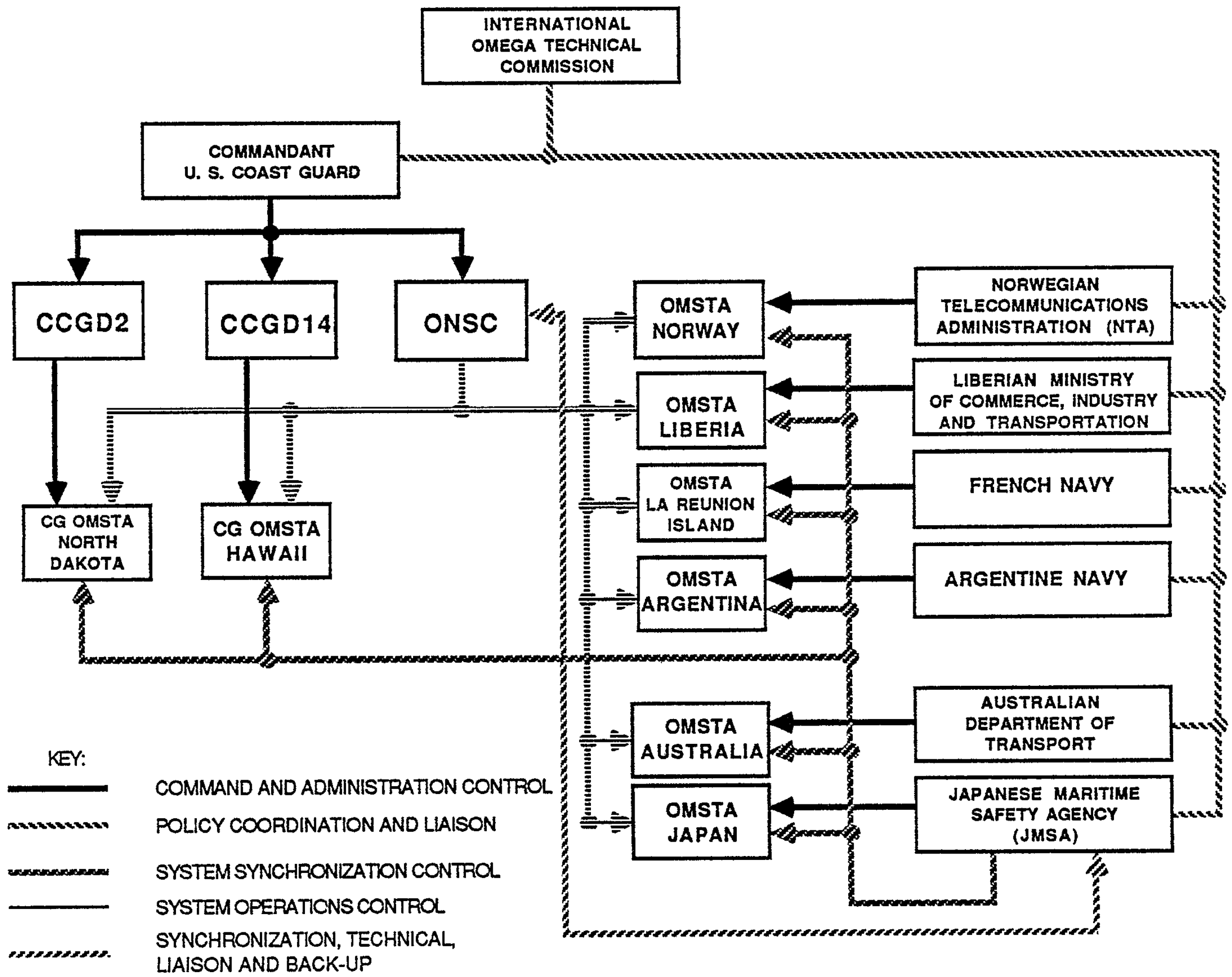
1. Basic Principles. The basic international organizational structure of the Omega Navigation system is established through bilateral agreements with partner nations as discussed in section 3.A.5. The ONSC is responsible for the operation of the Omega system subject to the policies and procedures set forth by the Commandant and consistent with the United States' obligations for Omega system operation under current bilateral agreements. It is in this context that the following basic principles are set forth. Figure 3-3 provides a basic diagram of command and control relationships.

2. Partner Nation Operating Agencies. The command, control and general administrative support of partner nation Omega transmitting stations and the monitor facilities operated by foreign operating agencies are the prerogative and responsibility of those agencies. Responsibility and authority necessary for the effective discharge of functional responsibilities are established by appropriate intergovernmental or interagency agreements. Technical and logistical assistance and support are provided to partner nation transmitting stations and monitor facilities under the terms of these agreements. Omega system operations will be shared with the partner nations through the International Omega Technical Commission. By agreement, the partner nation operating agencies may be assigned any or all of the functional responsibilities which Coast Guard commands exercise, including, when appropriate, those that are supervisory or directive in nature. For example, the Japanese Maritime Safety Agency (JMSA) is responsible for the Omega system synchronization.

3. Coast Guard Omega Operations

    a. All Coast Guard Omega operations, associated support activities and administrative functions are to be accomplished within the framework of the Coast Guard organization as described in the Coast Guard Organization Manual, COMDTINST M5400.7 (series). Each Coast Guard responsibility necessary to operate and support Omega is assigned to a specific Coast Guard Headquarters Office or field command. Deviation from the organizational assignments and procedures established herein are not authorized. If necessary, however, proposals for change may be submitted to Commandant (G-CCS) for consideration.

    b. The coordination and discharge of functional responsibilities will conform generally to the Coast Guard organizational chain of command and the lines of authority established by each partner nation within its own organization. The Commanding Officer, Omega Navigation System Center (ONSC) is the designated Coast Guard operational Commander serving as coordinator between the Coast Guard and each partner nation operating agency. To assure operational coordination, signal synchronization, and effective maintenance of station transmitting equipment, it is essential that certain technical functions be performed through direct channels of communication. Cognizant Coast Guard commands and partner nation operating agencies must be informed promptly of any unusual conditions which are detected during the discharge of responsibilities.



Omega Command and Control Relationships.

3.B.4. Coast Guard Headquarters.

a. The Commandant exercises the authority to:

(1) Establish and to approve changes to the basic organizational structure of the Coast Guard and assignments of major functional responsibilities.

(2) Initiate, or approve the initiation of, discussions with foreign officials which might lead to the establishment of formal intergovernmental or interagency agreements, or changes in the assignment of functional responsibilities and

(3) Promulgate and disseminate system technical performance information, including, but not limited to, performance standards, signal characteristics, system coverage, user documentation, and public notification of Coast Guard policy concerning the Omega system.

b. The Chief, Office of Navigation Safety and Waterway Services, as Program Director for the Radio navigation Aids (RA) Program, and acting under authority delegated by the Commandant, will provide policy guidance and will direct and coordinate service-wide functions necessary to accomplish the United States' responsibilities for operation and management of the Omega system.

c. The Chiefs of the Offices of Command, Control and Communications, Engineering, Personnel, Comptroller, the Chief of the International Affairs Staff, and other Headquarters Offices, as directors of support programs, will direct and coordinate service-wide functions necessary to support the Omega system.

d. Under the direction and supervision of the Chief, Office of Navigation Safety and Waterway Services, the Chief, Radio navigation Division (RA Program Manager) is assigned responsibility for the Omega system commensurate with those responsibilities presently assigned for the other Coast Guard operated marine radio navigation aids as set forth in the Coast Guard Organizational Manual, COMDTINST M5400.7 (series).

5. Area and District Control.

a. Although the Area Commander has no direct operational control over Omega, the Area Commander shall be advised of significant Omega operation and engineering evolutions planned or under-way, any changes in the system's operational status and any contingent requirements that may necessitate involvement of an Area Commander. For example, should the need arise to provide emergency shipment of critical Omega electronics equipment to one of the Omega stations by Coast Guard aircraft, this function would involve elements of the area staff and would be under the control of an Area Commander.

b. Commander, Second Coast Guard District and Commander, Fourteenth Coast Guard District exercise administrative control of Omega Stations North Dakota and Hawaii, respectively.

3.B.5. c. Submission of Officer Performance Reports for the Commanding Officers of the Omega stations in the Second and Fourteenth Districts shall be in accordance with District instructions. Commanding Officer, ONSC, shall provide concurrent OER's with respect to station operational performance for the Commanding Officers of Omega Stations North Dakota and Hawaii.

d. Omega monitor facilities are established at Coast Guard units in several districts. These units and their senior commands are authorized direct liaison with ONSC to ensure proper facility operation.

e. The above Commanders shall ensure that their subordinate units respond promptly and effectively to directions and instructions pertaining to Omega issued by Commanding Officer, ONSC, and the synchronization directives issued by the Japanese Maritime Safety Administration (JMSA). Included are those which, because of their vital importance to the operation of the Omega system, are passed through system control communications channels and by-pass established chains of command. Direct liaison among the districts, ONSC, and the Omega stations is authorized to the extent necessary to carry out the above responsibilities.

6. Omega Navigation System Center (ONSC).

a. System functions which are common to existing duties within the Coast Guard organizational framework have been assigned to the appropriate field commands. Task assignments unique to the Omega system have been assigned to ONSC.

b. The ONSC is a Headquarters unit under the technical control of the Chief, Office of Navigation Safety and Waterway Services, as defined in the Coast Guard Organization Manual, COMDTINST M5400.7 (series).

c. The mission of ONSC is to operate the Omega Navigation System so as to ensure that the system provides usable and dependable radionavigation information, conforming to established system standards. The ONSC operates the Omega system subject to policies and procedures set forth by the Commandant, and consistent with U. S. obligations for Omega system operation under current bilateral agreements.

d. In order to carry out it assigned mission, ONSC performs the following functions:

(1) Planning, Programming, Training, Budgeting. Provides timely information to the Program and Support Directors, pertainingto operational and support objectives for planning, programming and budgetary administration.

3.B.6.d. (2) Operations.

(a) Is directly responsible to the Program Manager for supervision and management of Omega system operations.

(b) Reviews all reports of Omega system and station operation. Ensures that corrective action is initiated when necessary. Ensures that any serious lapse in system integrity is thoroughly investigated and reported to higher authority.

(c) Coordinates scheduling of transmitting station off-air time.

(d) Ensures that Omega system navigation and time synchronization are maintained within established tolerances. Maintains operational station monitor network to provide:

1. Sychronization data to both MSA and ONSC which allows them to compute station phase shifter adjustments.

2. Real-time warning of Polar Cap Absoption (PCA) events.

3. System performance evaluation.

(e) Conduct periodic technical visits to each Omega transmittig station to assess general station readiness to accomplishits mission, and to perform field changes and operational testing and evaluation of the electronics equipment to assure that on-air performance is in accordance with established system standards. Closely coordinates such visits with the Coast Guard distric, Coast Guard Activities Europe (ACTEUR), and the partner nation agency responsible for the station.

(f) Develops Propagation Correction (PPC) Models to improve Omega accuracy. Complete model development requires:

1. Analytic semi-empirical framework developed either in house or under contract to provide sector or Navy Labs.

2. Data to fix model coeficients. Data is derived from about 50 Omega monitor sites around the world andis acquired, processed and stored in-house.

(g) Develops Omega signal coverage diagrams to assist the user community in proper utilization of Omega signals.

(h) Plans and conducts Omega system validation programs to evaluate signal performance, coverage predictions, and PPC accuracy. These will be conducted on a region-by-region basis.

(i) Computes Omega position accuracy and system availablity indices using all available sources. Determines existing station reliability figures to see if these meet system performance specifications.

3.B.6.d.(2) (j) Provides timely notification of system status changes including anomalous events, e.g. PCA's to organizations which issue navigation warnings and user information.

(k) Coordinates the dissemination of Omega system data necessary to support the production of Omega charts and tables.

(3) Support.

(a) Performs Omega System Maintenance Engineering Facility (SMEF) functions assigned by the Support Manager. The SMEF responsibilities are defined in COMDTINST 10550.11 (series).

(b) Coordinates Omega system logistics support requirements with Support Managers and CG Supply Center Brooklyn, NY.

(c) Performs Omega system depot level repair support with the Headquarters Support Manager.

(d) Coordinates on-the-job and formal training with Headquarters Support Managers.

e. The Commanding Officer of ONSC maintains technaical liaison with a number of U.S. and foreign agencies as outlined in paragraphs (1) through (4) below.

(1) With respects to foreign and international agencies and entities, ONSC performs a technical service for the Headquarters Program Manager by advising and otherwise dealing with system matters which may arise at partner nation stations.

(2) The ONSC sustains the day-to-day working relationships between and among partner nation stations and operating agencies. These include coordinating of plans, technical visits, logistics, system administration and operational requirements with partner nation agencies.

(3) The ONSC maintains technical liaison with monitor receiver facilities to sustain the Omega monitor program.

(4) The ONSC maintains working relationships with the following U.S. agencies which have technical expertise in one or more Omega program areas:

(a) Federal Aviation Administration (FAA) - Exchange technical information concerning airborne Omega receiver requirements, system warning information and regional coverage. specifications.

(b) Naval Sea System Command (NAVSEA) - Exchange technical information concerning Omega and VLF receiver development for Navy and Navy Omega coverage requirements.

3.B.6.e.(4)

(c) Naval Electronic System Command, Portsmouth, VA (NAVELEX)- Exchange technical information concerning VLF transmitter technology.

(d) Naval Ocean Systems Center (NOSC) - Exchange technical information concerning VLF electronics engineering, signal propagation and system validation support.

(e) U.S. Naval Observatory (USNO) - Information exchange concerning time and frequency uses of the Omega system.

(f) Defense Mapping Agency Hydrographic and Topographic Center (DMAHTC) - Exchange information concerning data for user charting requirments.

f. Summary. To accomplish the above mission and functions the Commanding Officer, ONSC, is the primary focal point for Omega system operations and coordination. The Commanding Officer, ONSC, is responsible for:

(1) Issuing supplementary written instructions necessary for the operation of the system.

(2) Visiting transmitting stations and monitor facilities to inspect and direct the operational adjustments of Omega equipment, and to instruct personnel in correct Omega operating procedures.

(3) Informing Commandant(G-NRN), cognizant Headquarters Support

Managers, and cognizant field commands (both Coast Guard and partner nation operating agencies) on matters requiring their attention.

(4) Assuring technical and logistics assistance is provided to the partner nation operating agencies and stations, as noted in the agreements.

(5) Assuring effective communication between all Omega system elements and Coast Guard support sources which serve them. The technical functions of operations control and system sychronization are illustrated in Figure 3-4.

(6) Exercising signature authority over all Omega Monitor site agreements subject to concurrence by Commandant (G_NRN and G-CPI) and with approval of the Department of State.

7. Liaison.

a. The coordination of a worldwide navigation system involves extensive contacts with foreign agencies as well as interested U.S. government agencies. To fulfill this obligation, ONSC shall:

(1) Coordinate transmitting system operations by mutually exercising responsibilities defined in the country-to-country agreements.

3.B.7. (2) Coordinate monitor operations by mutually exercising responsibilities defined in agreements with foreign sponsoring agencies and interservice support agreements (ISSA) with U.S. agencies.

(3) Coordinate and exchange Omega hydrographic and geodetic information with U.S. and foreign agencies; maintain liaison with agencies such as ICAO, IMO, IALA, IATA, IAIN and IOA to determine system usage and user problems.

b. Commandant (G-NRN) coordinates with U.S. agencies to develop system planning requirements consistent with the overall navigation goals of the U.S. and to use the resourses of other agencies as necessary to promote efficient attainment of system performance goals. Coordination is maintained with:

(1) Department of Transportation (DOT) - Coordinates national navigation planning and system policy for both marine and civil air user requirements.

(2) Department od Defense (DOD) - Coordinates military navigation planning and military user software requirements.

c. With the concurrence of Commandant (G-NRN), ONSC oversees the arrangements necessary to locate Omega monitor receivers at facilities controlled by U.S. and foreign agencies. Commandant (G-CPI) will coordinate with the Department of State (DOS) international agreements necessary for the operation of Omega monitor receivers in foreign countries.

C. **System Operation**

1. Synchronization. Synchronization of the Omega system's signals is a U.S. responsibility assigned to ONSC. On 17 October 1977, this functional role was delegated to the Japanese Maritime Safety Agency (JMSA). This does not, however, change basic U.S. responsibilities for performance of the function. The party responsibilities cannot be incorporated in the other country-to-country agreements since they are bilateral in nature. The ONSC provides a system synchronization back-up capability by maintaining the necessary data base in parallel with JMSA, but id relieved of the real time burden of this operational function. The USNO monitors and reports (in Series 4 announcements) Omega offsets from Universal Coordinated Time (UTC). System external links to UTC are provided by measurements, at four transmitting stations, of Omega epoch with reswpect to Loran-C and GPS measurements at several stations. The Loran-C timing link will be discontinued once GPS timing receivers are installed and tested at all stations. The control loop between JMAS and the transmitting stations, together with the UTC external comparisons, and the reciprocal path phase difference and cesium phase shifter data provided by the stations, complete the synchronization data requirements.

3.C.1. a. <u>Transmitting Stations</u>.

(1) The first level of synchronization of the Omega system takes place on the transmitting station. Each station is equipped with three cesium beam frequency standards and extensive electronic circuitry for controlling the phase of the frequency standard's output. On each station, one frequency standard is designated the reference or on-line standard. The remaining two standards are back-up units and are aligned with the on-line unit each day.

(2) Monitor receivers are used to compare the phase of remote Omega signals with the local station's signal. The resulting phase difference reading along with other data is sent by message to the Japanese Maritime Safety Agency (JMSA) Omega Synchronization Control Center (and an information copy to ONSC) once each week. The information received from each transmitting station is used by IMSA to develop adjustments for each station's Omega Signal Format Generators (OMSFOGs). The computed weekly corrections and four-hour adjustments ensure that each station's epoch, relative to Omega standard time, is maintained as closely as possible. The external data ensures that the system standard time is aligned with Universal Coordinated Time (UTC) within 5 microseconds. Omega standard time deviates from UTC only by the number of leap seconds inserted in UTC since Omega Standard Time commenced on 01 January 1972 at 0000Z.

2. <u>Station Operation</u>.

a. <u>Monitor Stations</u>.

(1) Omega monitor stations are currently operated at over 50 sites located throughout the world. The monitor stations consist of one Omega monitor receiver, one cassette recording device, and an antenna system for the receiver. The receivers are fully automated; and operation consists of the initial setting of desired parameters, a daily check to ensure proper receiver operation, and monthly replacement and mailing of the completed cassette recording. On those site where personnel are qualified, some replacement of non-functioning circuit boards may be performed. This minor trouble-shooting is directed by ONSC and additional maintenance, as required, will be performed by ONSC. These monitor stations are established and operated in accordance with agency-to-agency agreements or interservice support agreements if the stations are installed at the facilities of another U. S. agency.

(2) The propagation medium intervening between the signal source and the navigation receivers complicates system operation. The function of the monitor receiver is to sample the transmitted signals at fixed intervals from sites of sufficient geographic separation to ensure that analysis of the data obtained provides a reliable basis for refining the Propagation Correction (PPC) model. The ONSC adjusts and improves the computer-based PPC model which quantitatively describes the propagation of the

3.C.2.a. (2) (Cont'd) signal. This model provides the data necessary (given a time and rough position) to correct navigation receiver readings to actual geographic position. The correction data is provided to the Defense Mapping Agency Hydrographic Topographic Center (DMAHTC) which issues the propagation correction tables. In addition, the computer code and documentation which provide the propagation corrections are available in ONSC publications for use and adaptation by manufacturers of Omega navigation receivers.

b. Transmitting Station Operations. Operational control of the Omega Transmitting Stations is a U. S. (ONSC) responsibility as depicted in Figures 3-2 and 3-3. Day-to-day operation of the stations, however, falls under the cognizance of the partner nations' operating agencies. This day-to-day operationa follows the practices and procedures detailed in COMDTINST M16566.1 (series), Omega Navigation System Operations Manual.

3. Reporting and Record Keeping Requirements. Reporting and record keeping requirements for Omega stations are discussed in detail in Chapter 5, the Omega Navigation System Operations Manual, COMDTINST M16566.1 (series).

4. Support Relationships.

a. Various support relationships exist for the Omega system. Chapter 6 of the Omega Navigation System Operations Manual presents an overview of the logistics program for the Omega navigation system. Figure 3-4 illustrates the current relationships which are also delineated below.

(1) ONSC.

(a) Performs Omega System Maintenance Engineering Facility (SMEF) functions assigned by the Support Manager. The SMEF responsibilities are defined in COMDTINST 10550.11 (series).

(b) Coordinates Omega system logistics support requirements with Support Managers and CG Supply Center Brooklyn, NY.

(c) Performs Omega system depot level repair support with the Headquarters Support Manager.

(d) Coordinates on-the-job and formal training with Headquarters Support Managers.

(2) Coast Guard Activities Europe. Commander, Coast Guard Activities Europe (ACTEUR) provides non-electronic engineering consultation and assistance necessary to ensure adequate civil engineering support for Omega stations in Argentina, Norway, Liberia, and La Reunion. The level of support provided varies due to the corresponding country-to-country agreement, and supplemental technical agreements. Direct liaison, consonant with the basic command relationship, is authorized and encouraged among ACTEUR, ONSC, and the stations in support of these tasks.

3.C.4.a (2) (Cont'd) In addition, ACTEUR is responsible for providing the following station support:

(a) Perform Omega System Maintenance Engineering Facility (SMEF) functions assigned by the Support Manager. The SMEF responsibilities are defined in COMDTINST 10550.11 (series).

(b) Coordinate Omega system logistics support requirements with Support Managers and Coast Guard Supply Center Brooklyn, NY.

(c) Perform Omega system depot level repair support with the Headquarters Support Manager.

(d) Coordinate on-the-job and formal training with Headquarters Support Managers.

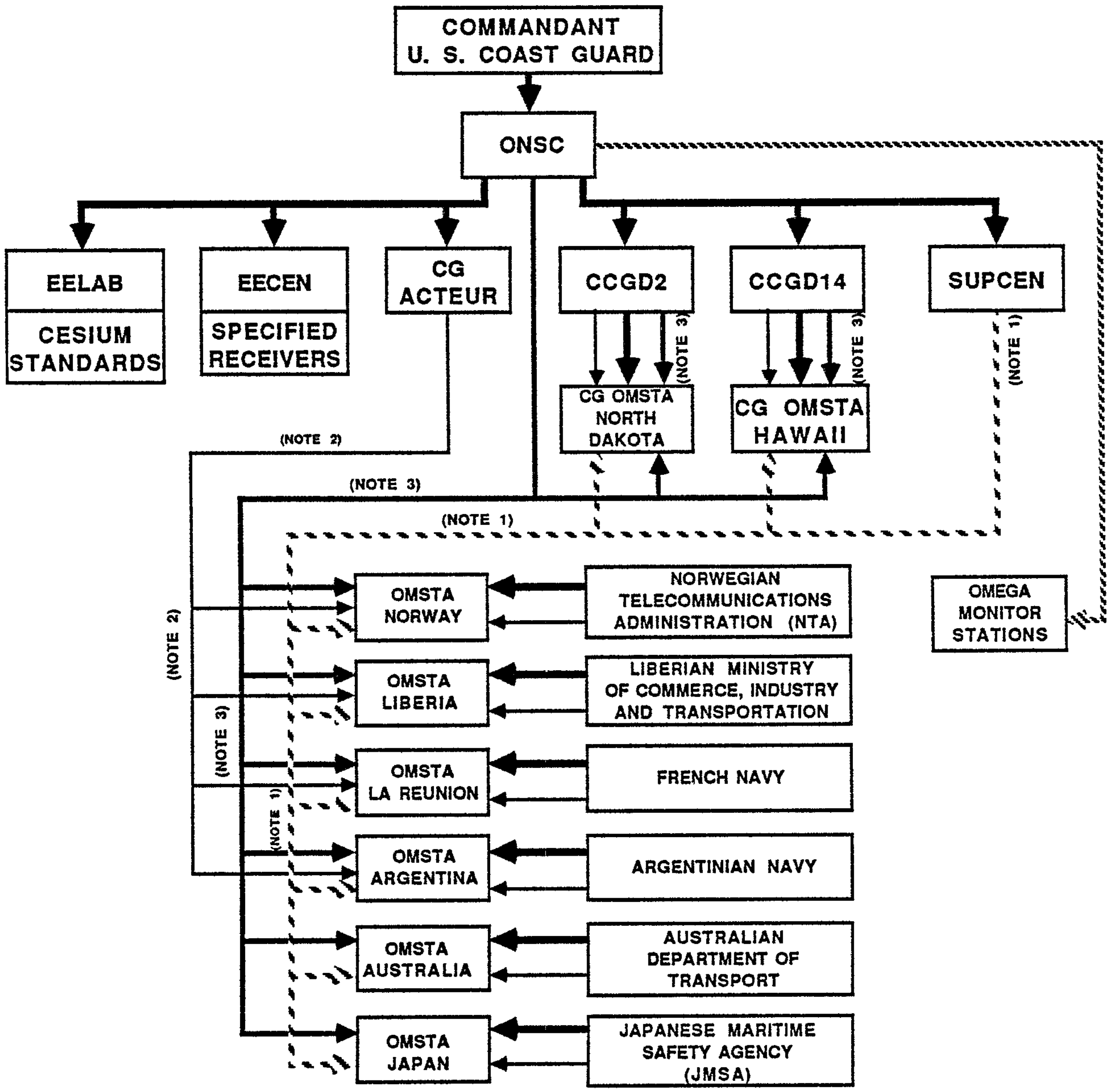
(e) Liberia-

1. Assist as necessary in major items of maintenance and improvement; i.e., OG43 items. These OG43 items are projects which are considered to be a major expense to the station and are not normal, ordinary, or routine. Generally, projects valued in excess of $2,000 fall in this category. All major casualty and alternation expenses are OG43. All normal, ordinary and routine operating and maintenance costs are chargeable to the station. Recurring maintenance items, even though they may cost more than $2,000, are not necessarily OG43 items. Examples of such recurring expenses are replacement of station batteries or procurement of fuel.

2. Liberia submits budget to ONSC, with a copy to ACTEUR. Items requiring ACTEUR engineering effort shall be specifically marked on the OMSTA budget submission and documented by SSMRs. Activities Europe will review budget from a facilities maintenance point of view with respect to OG43 projects and forward comments to ONSC. They will also provide ONSC an opportunity to comment on the prioritization of station's SSMRs.

3. Assume responsibility for those contracts involved in specific projects undertaken and managed by ACTEUR. Activities Europe may request the station to solicit contractors for various projects and to monitor the construction of these projects. Contracts chosen for station administration will be chosen at ACTEUR discretion. These contracts shall not normally include tower maintenance, inspection, or repair contracts.

4. Assist with plant improvements mutually agreed upon by the station, ONSC, and ACTEUR.



KEY:

- COMMAND AND ADMINISTRATION
- SUPPLY
- CIVIL ENGINEERING INCLUDING TRANSMITTING ANTENNA
- ELECTONICS ENGINEERING - OMSTA
- ELECTONICS ENGINEERING - MONITOR

NOTES:

1. CG SUPPORT FOR PARTNER NATIONS GENERALLY LIMITED TO ERPAL REPLENISHMENT.
2. LEVEL OF CG CIVIL ENGINEERING SUPPORT FOR PARTNER NATIONS INDICATED VARIES ACCORDING TO TERMS OF BILATERAL AGREEMENTS.
3. CG DISTRICT ELECTRONICS SUPPORT IS LIMITED.
4. OMEGA MONITOR RECEIVER SUPPORT GENERALLY ONSC RESPONSIBILITY.

Omega Support Relationships

3.C.4.a(2)(e) 5. Stock initial spares coinciding with ACTEUR projects. All tower spares shall be the specific responsibility of ACTEUR. Safe storege of spares shall be the responsibility of the OMSTA.

6. Maintenance of major items like road repairs and repaving.

7. Assist with major energy conservation projects designed to reduce fuel costs.

8. Inspect and maintain any major antenna, ground system, lighting projects, or any additions made to the antenna and ground system. This includes any antenna tools or special equipment. The station shall be responsible for any routine or minor tower repair, maintenance and or trouble shooting. An example of minor repair is tower relamping.

9. Maintain the station civil engineering records, drawings, and engineering data. The station will assist by periodically sending updates of station drawings to ACTEUR, red-lined to reflect any modifications made to station equipment or grounds.

10. Provide consultation, upon request, to determine required training in non-electronics equipment repair and maintenance. Activities Europe will, upon request, provide on-the-job training on plant operation during regular station visits, recommend training for various station personnel, and review job training requirements for various non-electronic postions.

11. Make safety inspections, with station concurrence, during each visit by ACTEUR personnel.

(f) Norway-

1. Advise the Norwegian Telecommunications Administration (NTA) regarding non-electronic maintenance.

2. Assess antenna inspections and maintenance.

3. Review the station's annual budget regarding non-electronic items and advise ONSC as appropriate.

(g) La Reunion-

1. Conduct joint antenna inspections annually.

3.C.4.A.(2) (h) Argentina

1. Provide non-electronic technical advice and assistance to the extent provided for in the supplemental agreement.

2. Provide antenna inspections every other year.

(3) Coast Guard Supply Center Brooklyn. Commanding Officer, Coast Guard Supply Center Brooklyn provides electronic parts support for Omega electronic equipment and certain other parts peculiar to Omega transmitting stations. The logistics support to the partner nation stations is in accordance with the bilateral agreements and supplemental technical agreements. In addition Commanding Officer, Coast Guard Supply Center Brooklyn, the Electronics/General Inventory Control Point (E/GICP) for the Coast Guard, provides logistics support for ONSC and the Coast Guard Omega stations, commensurate with that provided other Coast Guard units. To the extent that electronics engineering support-related actions are consistent with policy and procedures contained in the Electronics Manual, COMDTINST M10550 (series), or have otherwise been approved by the Chief, Electronics Engineering Division, direct liaison between ONSC and the Supply Center is authorized.

(4) Coast Guard Information Systems Center. Commanding Officer, Coast Guard Information Systems Center, provides repair, maintenance, and support for all Omega cesium standards. Procedures governing repair and replacements of these standards are detailed in section 5.8.4 of COMDTINST M10550.13 (series). To the extent that electronics engineering support-related actions consistent with policy and procedures contained in the Electronics Manual, COMDTINST M10550.13 (series), or have otherwise been approved by the Chief, Electronics Engineering Division, direct liaison between ONSC and Coast Guard Information Systems Center is authorized. Additionally, the Coast Guard Information Systems Center provides various administrative, supply and support activities to ONSC, in accordance with the terms of a support agreement between in two units.

LIST OF ABBREVIATIONS

ACTUER	Activities Europe
ACQ	Acquisition
AUTM	Authorized Unusable Time
BK	Blink
CALOC	Calculator Assisted Loran Controller
CASCOR	Casualty Correction
CASREP	Casualty Report
CCMP	Control, Communications, and Monitor Plan
CCTD	Cross Chain Time Difference
CFR	Code of Federal Regulations
CLIF	Current Loop Interface
CM	Chain Manager
CO	Commanding Officer
COCO	Coordinator Of Chain Operations
COLO	Chain Operations Liaison Officer
COMDTINST	Commandant Instruction
COMLANTAREA	Commander Atlantic Area
COMPACAREA	Commander Pacific Area
CONPOL	Control Policy
CPR	Cardiopulmonary Resuscitation
CRS	Chain Recorder Set
CSECD	Controlling Standard Envelop to Cycle Difference
CSTD	Controlling Standard Time Difference
CW	Continuous Wave
DESLOT	Deenergized Standby Loran Transmitter
DMAHTC	Defense Mapping Agency Hydrographic and Topographic Center

DOD	Department of Defense
DOS	Department of State
DOT	Department of Transportation
DP	Droop
DPM	Digital Panel Meter
ECD	Envelop to Cycle Difference
ED	Envelope Deviation
EECEN	Electronic Engineering Center
EELAB	Electronic Engineering Laboratory
ELECTRONALT	Electronic Alteration Request
EN	Envelope Nominal
ENVCR	Envelope Number Correction
EPA	Electrical Pulse Analyzer
ET	Electronics Technician
ETA	Envelop Timing Adjust
EUTM	Emergency Unusable Time
E/GICP	Electronics/General Inventory Control Point
FAA	Federal Communications Commission
FRP	Federal Radionavigation Plan
FSS	Flight Service Station
GD	Gain Deviation
GMT	Greenwich Mean Time
GPS	Global Positioning System
IAIN	International Association of Institutes of Navigation
IALA	International Association of Lighthouse Authorities
IATA	International Air Transport Association

ICAO	International Civil Aviation Organization
IMO	International Maritime Organization
IOA	International OMEGA Association
IOTC	International OMEGA Technical Commission
ISSA	Interservice Support Agreement
JMSA	Japanese Maritime Safety Agency
LCN	Local Cycle Number
LEN	Local Envelope Number
LF	Low Frequency
LNB	Large Navigational Buoy
LOIS	Loran Operations Information System
LORDAC	Loran Data Acquisition set
LORMONSITE	Loran-C Monitor Site
LORSTA	Loran Station
LPA	Local Phase Adjustment
LSOS	Local Site Operating Set
MMSE	Minimum Mean Square Error
MONSTA	Monitor Station
MPA	Maintenance Phase Adjustment
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NAVELEX	Naval Electronic System Command
nm	Nautical Mile
NOSC	Naval Ocean Systems Center
NOTAM	Notice To Airmen
nsec	Nanosecond
NTA	Norwegian Telecommunications Administration

OER	Officer Evaluation Report
OIC	Officer In Charge
OMSFOG	OMEGA Signal Format Generator
OMSTA	OMEGA Station
ONSC	OMEGA Navigation System Center
ONSOD	OMEGA Navigation System Operations Detail
OPORDER	Operation Order
OOT	Out Of Tolerance
OTBK	Out of Tolerance Blink
PAL	Personnel Allowance List
PA	Power Amplifier
PCA	Polar Cap Absorption
PCS	Permanent Change of Station
PCI	Phase Code Interval
PCMS	Primary Chain Monitor Set
PGEN	Pulse Generator
PM	Program Manager
PPC	Propagation Correction
PRP	Peak Radiated Power
PTTI	Precise Time and Time Interval
RA	Radio Aids
RATT	Radio Teletype
RCI	Remote Control Interface
RCVR	Receiver
RF	Radio Frequency
Rr	Radiation Resistance
RM	Regional Manager

RMS	Root Mean Squared
RMSI	Regional Manager's Supplemental Instructions
ROS	Remote Operating System
RSOS	Remote Site Operating Set
SAU	Status Alarm Unit
SID	Sudden Inospheric Disturbance
SITREP	Situation Report
SM	Support Manager
SMEF	Systems Management and Engineering Facility
SOP	Standard Operating Procedures
SSMR	Shore Station Maintenance Request
SSX	Solid State Transmitter
STO	Senior Technical Officer
SYNC	Synchronization
TAC	Transmitter Automatic Controller
TCC	Transmitter Coupler Controller
TD	Time Difference
TDD	Time Difference Deviation
TDN	Time Difference Nominal
TIC	Time Interval Counter
TINO	Timing Interval Number
TOC	Time of Coincidence
TTX	Tube-Tupe Transmitter
TTY	Teletype
UPS	Uninterruptable Power Supply
USC	United States Code
sec	Microsecond

USNO	United States Naval Observatory
UTC	Coordinated Universal Time
UTS	Universal Time Second
UUT	Unusable Time
VLF	Very Low Frequency
Vp	Peak Voltage

A1: Alpha-1 Monitor.

A2: Alpha-2 Monitor.

ACTEUR: Coast Guard Activities Europe.

AECD: Assigned Envelope-to-Cycle Difference. The current ECD assignment at a transmitting site which, given existing propagation conditions, results in the CSECD being observed at the monitor.

AIG: Address Indicator Group.

ALPHA CONTROL: Baseline control is being performed by the designated control station.

Antenna Current: The signal at a LORAN-C transmitting station taken from the transmitting antenna ground return. This waveform is used at the transmitting station to monitor and measure and LORAN-C pulse.

AUTM: Authorized Unusable Time. Scheduled off-air period(s) proposed to the AIG and the users so they are given an opportunity to comment or object.

Blanking (Priority, Alternate): The suppression of the transmission on one rate due to the periodic phenomenon that occurs when a dual rated transmitting station has a transmit the pulse groups of different rates at the same (or nearly the same) time. During the period of overlap, one rate's pulses are transmitted and the other is suppressed or blanked. Priority blanking occurs when the same rate is always blanked while alternate blanking occurs when the two rates are blanked in an alternating manner.

BRAVO CONTROL: Baseline control is being performed by the master transmitting station.

CALOC: Calculator-Assisted Loran Controller.

CD: Coding Delay. The time a secondary station waits after it receives the master's pulse before it transmits.

CEC: Canadian East Coast Loran Chain.

CHARLIE CONTROL: Baseline control is being performed by a non-baseline secondary transmitting station.

CM: Chain Manager.

COCO: Coordinator Of Chain Operations.

COMMS: Communications.

CS: CONTROL STATION.

CSECD: Controlling Standard Envelope-to-Cycle Difference. ECD maintained at the monitor site as determined by chain calibration.

CSTD: Controlling Standard Time Difference. The reference standard against which the control station compares the Time Difference observations of the Alpha-1 Monitor.

DELTA CONTROL: Baseline control is being performed by the secondary transmitting station.

ECD: Envelope-to-Cycle Difference. The relationship between the phase of the RF carrier and the time origin of the envelope wave form.

ED: Emission Delay: The time interval between the master station's transmission and the secondary station's transmission in the same Group Repetition Interval.

EECEN: Electronic Engineering Center, Wildwood, NJ.

EELAB: Electronic Engineering Laboratory, Alexandria, VA.

EPA: Electrical Pulse Analyzer.

ETA: Envelope Timing Adjustment.

EUTM: Emergency Unusable Time. AUTM which did not give the users sufficient time to comment or object.

FESEC: Coast Guard Far East Section Office.

GL: Great Lakes Loran chain.

GRI: Group Repetition Interval. The time interval between successive pulse groups measured from the third cycle (or zero crossover) of the first pulse of any one station in the group to the third cycle of the first pulse of the same station in the following pulse group. All stations in a chain have the same GRI, and the GRI, expressed in tens of microseconds, is the identifier for that chain, and is called the chain "rate". GRI's may range from 40,000 microseconds to 99,990 microseconds, in increments of 10 microseconds.

HCG: Half-Cycle Generator.

KHz: Kilohertx, 1,000 cycles per second.

LABSEA: Labrador Sea Loran chain.

LANTAREA: Coast Guard Atlantic Area.

LEN: Local Envelope Number.

LOIS: Loran Operations Information System.

LOP: Line Of Position.

LORAN: Long Range Aid to Navigation.

LORMONSITE: Loran Monitor Site.

LORMONSTA: Loran Monitor Station.

LORSTA: Loran Station.

LPA: Local Phase Adjust.

LSOS: Local Station Operating System.

LSM: Local Status Monitor.

LTCE: Loran Timing and Control Equipment.

MEDSEA: Mediterranean Sea Loran Chain.

Mhz: Megahertz, 1,000,000 cycles per second.

MON: Monitor.

MOM: Momentary.

MPA: Maintenance Phase Adjust.

NECD: Nominal Envelope-to-Cycle Difference. The ECD held at the transmitting station which, given the identical propagation conditions which existed during the chain calibration, would result in the CSECD being observed at the monitor.

NEUS: Northeast U.S. Loran-C chain.

NM: Nautical Mile.

OJT: On-the-Job Training.

OOT: Out-of-Tolerance.

PACAREA: Coast Guard Pacific Area.

PATCO: Pulse Amplitude Timing Controller.

PCI: Phase Code Interval. Interval over which the phase code repeats itself. Loran-C phase codes repeat every two GRI's.

PCMS: Primary Chain Monitor Set.

PGEN: Pulse Generator.

PPS: Pulse(s) Per Second.

PRP: Peak Radiated Power.

PTTI: Precise Time and Time Interval.

PULSE LEADING EDGE: The portion of the pulse from the beginning to the peak (about the first 65 microseconds) of the Loran-C pulse.

PULSE TRAILING EDGE: The portion of the Loran-C pulse following the peak.

RAU: Remote Alarm Unit.

RCI: Remote Control Interface.

RCVR: Receiver.

RM: Regional Manager.

RMTE: RM Telecommunications & Electronics (CCG).

RMSI: RM Supplemental Instructions.

ROS: Remote Operating System.

RSOS: Remote Site Operating System.

SAU: Status Alarm Unit.

SDA: Signal Distribution Amplifier.

SEUS: Southeast U.S. Loran chain.

SITE: Normally an unwatched, unstaffed facility.

SM: Statute Mile.

SNR: Signal-to-Noise Ratio.

SSX: Solid-State Transmitter.

STANDARD ZERO CROSSING: The positive zero crossing at 30 microseconds of a positive phase coded pulse on the antenna current waveform. This zero crossing is phase-locked to the LORAN-C station's cesium time reference. The standard zero crossing is used as a timing reference for measurement of LORAN-C signal specifications.

STATION: Normally a staffed facility, either watched or unwatched.

STBY: Standby.

STO: Senior Technical Officer.

SYNC: Synchronization Number.

TAC: Transmitter Automatic Controller.

TCE: Timing & Control Equipment.

TCS: Transmitter Control Set.

TD: Time Difference. The interval in time between the receipt of the master and secondary station's signal of the same area.

TECH: Technician.

TELCO: Telephone Company.

TELEX: Teleprinter Exchange: A commercial message (telegram).

TIC: Time-Interval Counter.

TINO: Timing Number.

TMR: Timer.

TOA: Time of Arrival.

TOPCO: Transmitter Operation Controller.

TOL: Tolerance.

TPC: Two-Pulse Communications. In this format, the seventh and eighth pulse in each grou are subject to pulse-position modulation of 1 microsecond while TPC is being transmitted. When TPC information is not being transmitted, these pulses are not modulated. TPC is used only for back-up control communications and is typically used less than 2% of the time (annual average). (For a comprehensive description of TPC see "THE COAST GUARD TWO-PULSE COMMUNICATION SYSTEM", D. A. Feldman, et. al., "PROCEEDINGS OF THE INSTITUTE OF NAVIGATION NATIONAL MARINE MEETING ON LORAN-C, OCTOBER, 1975"; available from ION, 815 15th Street, NW, Suite 832, Washington, DC 20005.)

TS: Transmitting Station.

TTY: Teletype or Teleprinter.

UNK: Unknown.

UNMANNED: A facility with no personnel assigned for full time duties to maintain the site. Maintenance personel are usually shared on an as needed basis with a nearby facility.

UNWATCHED: Generally a facility that is manned but at which there is not a watchstander observing the equipment/baseline status aat all times.

UPS: Uninterruptable Power Supply.

s: Microsecond.

USNO: United States Naval Observatory.

UTC: Coordinated Universal Time.

VAU: Visual Alarm Unit.

W: Whiskey LORSTA or signals.

WATCHED: Generally a facility that is staffed where there is watchstander observing the equipment/baseline status at all times.

X: Xray Secondary or signals.

XMTR: Transmitter.

Y: Yankee Secondary or signals.

Z: Zulu Secondary or signals.